RUSSELL on STRANGE PHENOMENA

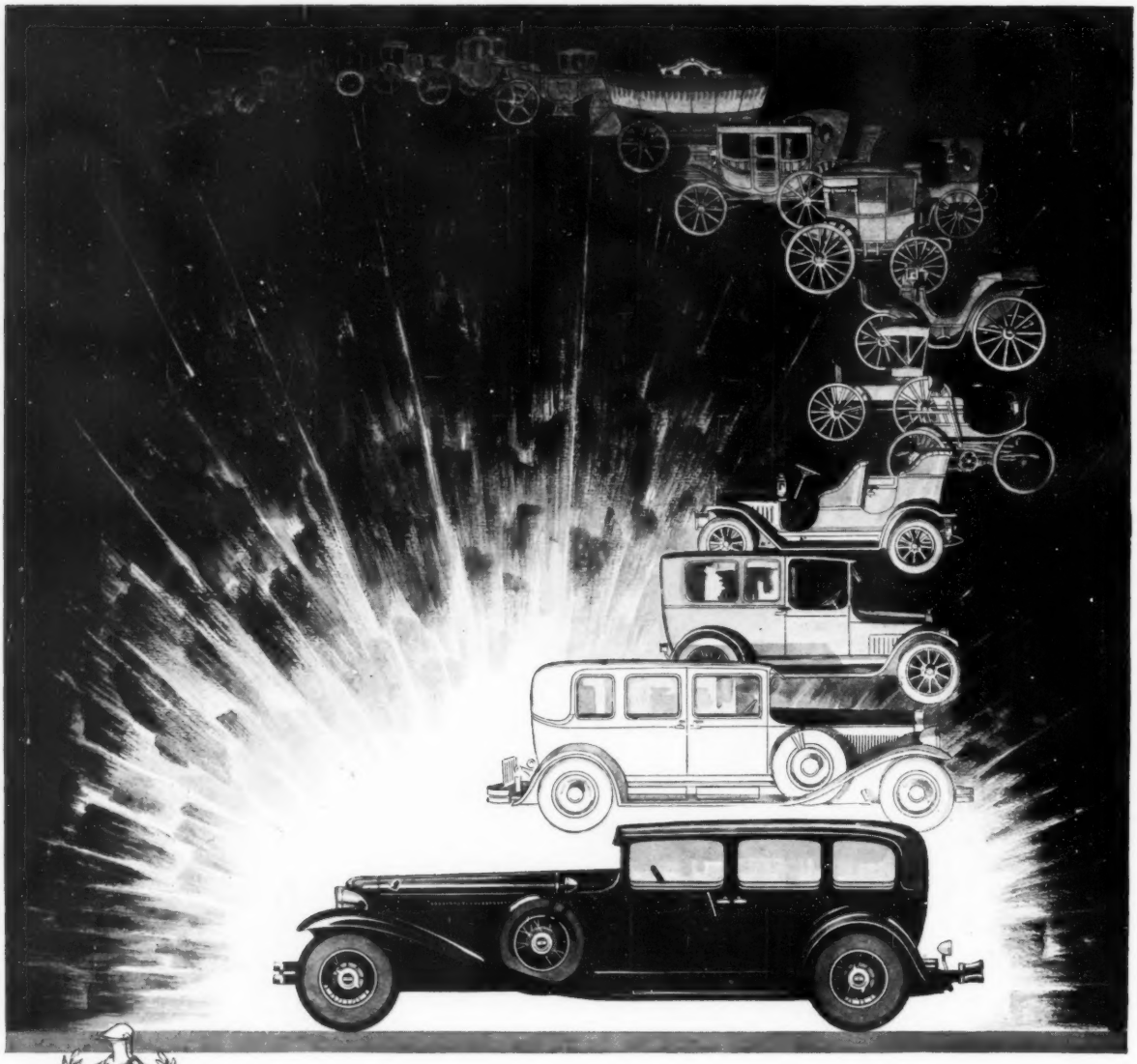
Walking on Water—Diamonds Fingerprinted

SCIENTIFIC AMERICAN

UNIVERSITY LIBRARY
RECEIVED
JUL 15 1930

August 1930 35¢ a Copy

Fighting Bark Beetles With Fire



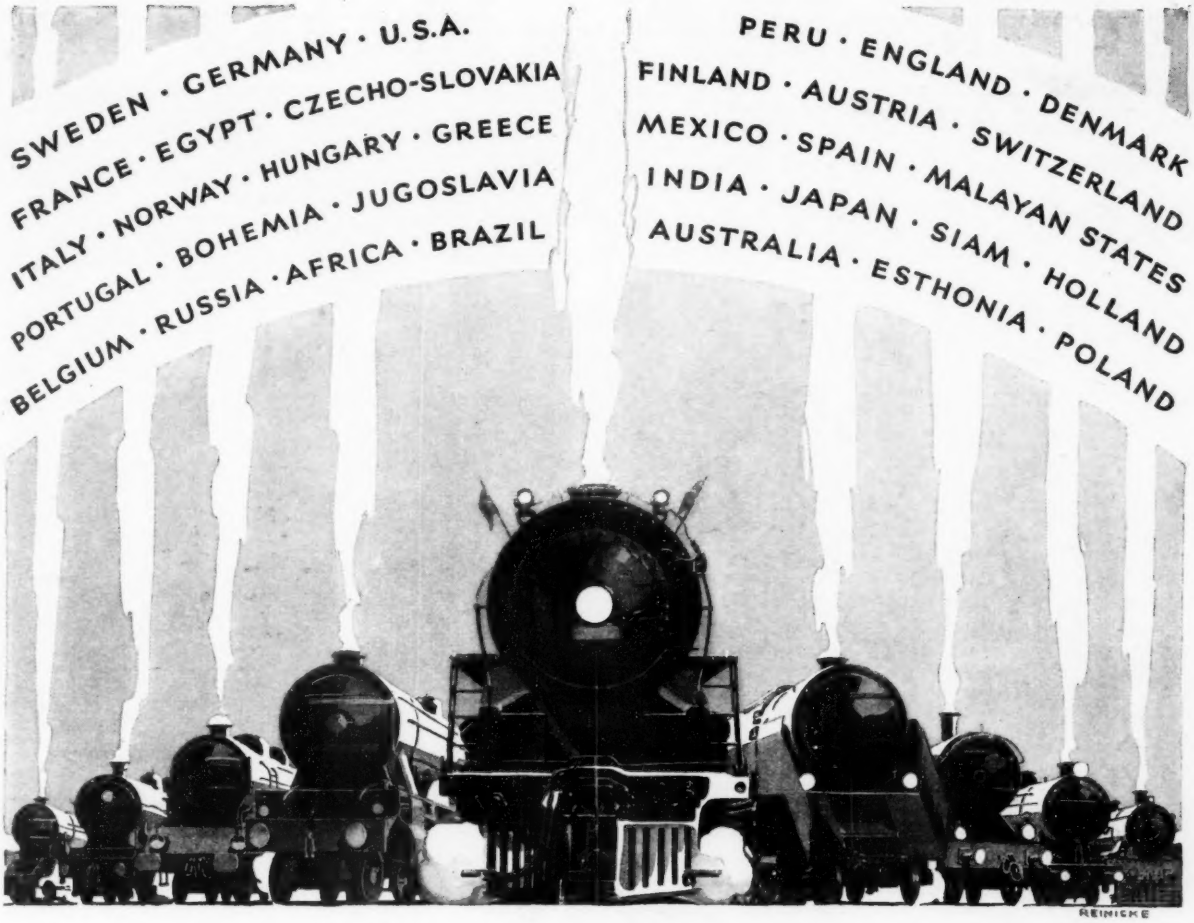
You cannot appraise the Cord with any rear drive automobile in terms of each other.

CORD

FRONT DRIVE

SEDAN $3095 . . BROUGHAM $3095 . . CABRIOLET $3295 . . PHAETON $3295 Prices F. O. B. Auburn, Indiana. *Equipment other than standard, extra*

AUBURN AUTOMOBILE COMPANY · AUBURN, INDIANA


SWEDEN · GERMANY · U.S.A.
FRANCE · EGYPT · CZECHO-SLOVAKIA
ITALY · NORWAY · HUNGARY · GREECE
PORTUGAL · BOHEMIA · JUGOSLAVIA
BELGIUM · RUSSIA · AFRICA · BRAZIL
PERU · ENGLAND · DENMARK
FINLAND · AUSTRIA · SWITZERLAND
MEXICO · SPAIN · MALAYAN STATES
INDIA · JAPAN · SIAM · HOLLAND
AUSTRALIA · ESTHONIA · POLAND
REINICKE

On the railroads of the world

. . . including its four crack trains!

WHAT'S all this conversation on railway journal bearings about anyway? Why, **SKF** put its first Spherical Bearing into a railway journal so long ago that **SKF** had just about forgotten that this is supposed to be some sort of a super-bearing feat. Of course, it is a tough job for a bearing . . . that is if it stays on the job. But tackling that kind of an assignment is everyday business for **SKF**. Why, there are more **SKF** Bearings . . . many times more . . . in railroad service than all the other bearings of the world combined.

It was sixteen years ago that an **SKF** Bearing went into a journal box for the first time. Since then, that first bearing has been followed by 71,999 other bearings for locomotives, tenders, dining cars, baggage and passenger cars . . . in 33 countries throughout the world.

Get this significant fact when you judge bearing performance by railroad records . . . **SKF** Bearings are used on the four crack trains of the world—The Broadway Limited, The 20th Century Ltd., the Blue Train* of France and the Rheingold Express of Germany!

For, mark you this fact now. The railroads of the world find it far too expensive to buy a bearing on the basis of price . . . which means that the only thing left for consideration is performance . . . and that in turn means **SKF**—always. **SKF** Industries, Incorporated, 40 East 34th Street, New York, N. Y.

SKF

* The Calais-Mediterranean Express

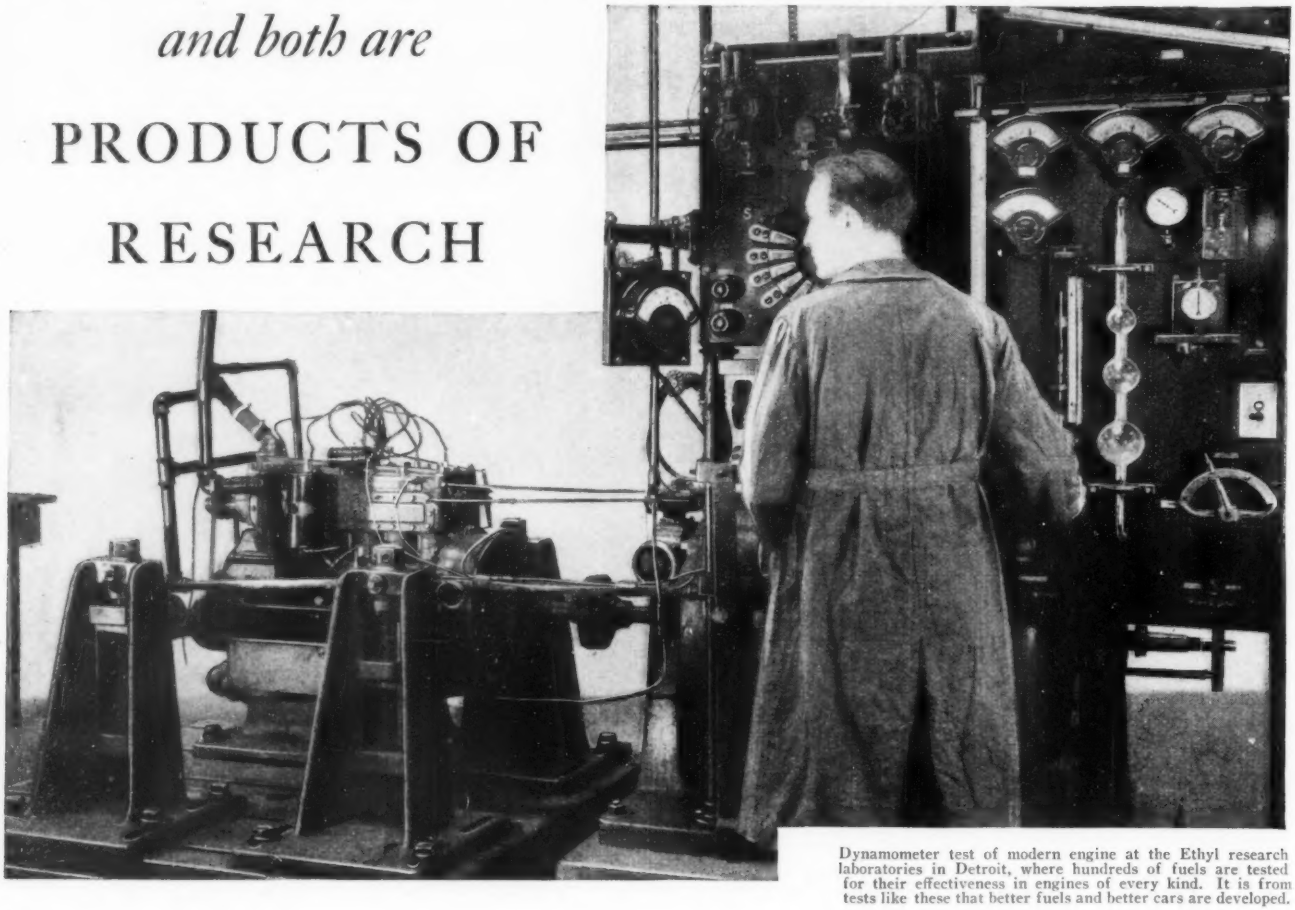
2502

"THE HIGHEST PRICED BEARING IN THE WORLD"

BETTER FUELS *mean* BETTER CARS

and both are

PRODUCTS OF RESEARCH



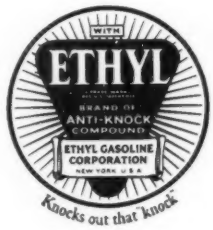
Dynamometer test of modern engine at the Ethyl research laboratories in Detroit, where hundreds of fuels are tested for their effectiveness in engines of every kind. It is from tests like these that better fuels and better cars are developed.

THE research laboratories of the Ethyl Gasoline Corporation have contributed materially to the development of better automobile engines and better fuels for their operation. Ethyl engineers are constantly working with car manufacturers and oil refiners toward still greater improvement in motor car performance.

A result of this extensive research was the introduction of high-compression automobiles in 1927. In that year only about 14 per cent of the new car models were high compression (5 to 1 ratio or better) but in 1928 the proportion had grown to 56 per cent. In 1929 it was 77 per cent and this year approximately 84 per cent of the new models are of this type.

Oil companies selling more than three quarters of all the gasoline used in the United States and Canada mix Ethyl anti-knock fluid with good gasoline to form Ethyl Gasoline. Ethyl fluid, itself a product of research, was developed primarily to make possible the high-compression cars. These cars require a fuel of Ethyl's anti-knock quality to deliver the higher efficiency of which they are capable, but Ethyl improves the performance of *any* car, whatever its type, size or age.

Try Ethyl Gasoline yourself, put it to any test. On sale everywhere at pumps bearing the emblem shown at the right. Ethyl Gasoline Corporation, Chrysler Building, New York City.



Wherever you drive—whatever the oil company's name or brand associated with it—*any* pump bearing the Ethyl emblem represents quality gasoline of high anti-knock rating.

The active ingredient used in Ethyl fluid is lead.

© E. G. C. 1930

ETHYL GASOLINE

Scientific American, August, 1930, Vol. 143, No. 2, entered at the New York, N. Y., Post Office as Second Class Matter June 28th, 1879, under the Act of March 3rd, 1879; additional entry at Dunellen, N. J. Published Monthly by Scientific American Publishing Co., 24 West 40th Street, New York City. Copyright 1930 by Scientific American Publishing Co. Great Britain Rights Reserved. Subscription Price $4.00 per year.

SCIENTIFIC AMERICAN

August 1930 — *ORSON D. MUNN, Editor* — *Eighty-sixth Year*

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

IN THIS ISSUE

Across the Editor's Desk 85

Back of Frontispiece—Austin H. Clark 87

Frontispiece—Skavlem the Flint Flaker 88

Fire: the Enemy of Our Forests—By C. W. Geiger and Wallace Hutchinson 89
Methods of Preventing and Fighting Forest Fires

Our Point of View—Editorials 93
The Improved Patent Situation; Sir Henry Segrave; Returning Prosperity; Navies and World Problems

Photography Identifies Gems by Their Flaws—By Frank Heitzler 94
Internal Structure of Gems Recorded for Future Reference

Walking on Water—By Henry J. Tomlinson, B.Sc. 96
The Water Skipper Does Not Swim; He Walks on the Surface

St. Louis Buries a River—By W. W. Horner 98
River Subject to Devastating Floods is Enclosed in Huge Sewer

Accuracy in "Talkie" Equipment 103
Exceedingly Accurate Methods of Manufacture are Necessary

Zoogenesis—By Austin H. Clark 104
The New Theory of Evolution

Dining in a Refrigerator 108
Air Cooling Equipment Applied to a Railroad Dining Car

Built of Mud—By A. Hyatt Verrill 110
Elaborate Modern Buildings in Peru are of Adobe

Basic Patents in Evolution—I—By William K. Gregory 112
Foundation Structures of the Human Body

The "Green Flash" and Other Odd Phenomena—By Henry Norris Russell, Ph.D 114
Seeing the Green Rays of the Sun; Mirages

Film Yourself for a Quarter 117
New Machine Makes Curious "Movie Portrait"

Perfume—By Martin Meyer, Ph.D 118
Bottled Agreeable Odors From Tons of Flowers

The Eight-Inch Gun Cruiser—By Captain W. D. Puleston, U. S. N 120
Its Historical Background and Present Development

A Home-made Microscope for the Amateur—By Leon J. Israelovitch 123
Water is Used for Lenses, and the Microscope is Inexpensive

Work and Fatigue—By Donald A. Laird, Ph.D., Sci. D. 124
Industrial Fatigue is Passing Out Of Style

Rome's Slums Reveal Imperial Ruins 127
When Modern Buildings Are Torn Down, Roman Ruins Emerge

The Imperious Sycamore—By William Alphonso Murrill 128
An "Appreciation"

Vegetables That Defeat Goiter—By M. Bishop Alexander 130
Iodine-Containing Produce Grown in Abundance

Mechanical Silkworms—By Grace Lockhart 132
Man Now Beats the Worm in Producing Delicate Filaments

"Panama" Hats From the Pacific—By Hendrik de Leeuw 134
Various Head Coverings From Many Fibers Made in East Indies

The SCIENTIFIC AMERICAN Digest

Of General Interest

Movies Aid in Testing 136
Fire War on Tree Pests 136
Death of Elmer A. Sperry 137
Picture in Natural Wood (Illustration) 137
Cobalt Steel in Motor (Illustration) 137
Seamless, Endless Tube 138
City Trees Often Gassed 139
Fingerprint-Lifting Tape 139
Aluminum in Colors 139
Max Valier—Rocket Martyr 141
How a Tree Grows (Illustration) 141
Insulator and Conductor 142
Ediphone for Road "Logging" 143
Huge Testing Machine 143
Electrical Water Heater 144
Outboard Motor Moves Piles 144
Roller Bearing Locomotive 146
Shoe-Making Machine (Illustration) 146
Furnace Air Filter (Illustration) 148

Aviation

Air Traffic Control Systems 137
Navigation in the Air 141
Novel Landing Float 141
Aeronautical Equipment 143
Launching Planes from Airships 143
Blind Spots and Collisions 145
A Plane Price War 148
Regulating Air Transport Services 149

Chemistry

New Metal in Plumbing Industry 137
Electrolene and Cheap Hydrogen 138
Detecting Deadly Sewer Gases 138
Light Alloys 140
Sparkle in Soft Drinks 140
Two Freak Metals 142
New Rubber Blocks X rays 145
Welding Copper Made Easy 148

Medical Science

Food Poisoning 137
Canned Salmon Prevents Disease 138
Overweight Children 140
Bread 141
A Pin in the Stomach 143
Ants In Indian Surgery 144
Heredity 146
Fever and Radio Waves 148

The Amateur Astronomer 150

Current Bulletin Briefs 152

Commercial Property News 156

Attorney's Delay Unavoidable 156
Patents in War Settlements 156
Reduction to Practice Governs Priority 156
British Mail Ban on Cigarettes 156
Limited Novelty—Limited Claims. 156
Pay for Service Not "Free" 156
"Army and Navy Supplies" May be Misleading 157
Parachutes are Developing 157
"Dry Ice" Package Patent Valid 157
Malt Product Mark Restrained 157

Patents Recently Issued 157

COVER

In sections of the west, a beetle which makes its home under the bark of trees has been making heavy inroads on the forests. Our cover this month, painted by Howard V. Brown, shows the latest and most effective method yet conceived to destroy the pests—the scorching of the bark by spraying kerosene on the trunk and setting fire to it. Turn to page 136 for the article concerning this work.

New Frontiers of Physics

By Paul R. Heyl, Ph. D.,
Physicist, U. S. Bureau of Standards

AMONG present-day scientific writers it is doubtful that anyone has a more brilliant flare for the explanation of obstruse scientific facts in terms understandable to the layman, than this well-known physicist and outstanding thinker. Matter, energy, space, time, gravitation, cosmology, wave atoms, these high points indicate the extent of this new work. It is broad in scope, medium in depth and contains much solid lean meat, no fat, no padding and almost no mathematics. A timely work for those who wish to keep abreast of the times.

$2.15 postpaid domestic

Amateur Telescope Making

Albert G. Ingalls, Editor

JULY skies intrigue one to trace out the constellations, identify the planets and major stars and revel in the glory of the Milky Way. So much more can be enjoyed if one has a telescope and this is readily obtained at small cost by the interesting labor of making your own. Full, explicit, simple, understandable directions are given of each step in sequence so that the average person of moderate skill with the hands can easily build a worth-while instrument.

$3.00 postpaid, domestic

Outboard Motor Boats and Engines

By Bradford Burnham

WITH the increasing interest in outboard motors for private use as well as racing, this outstanding book on the subject gives the interesting story of the development of this unique power plant as well as a description of the various types, with explicit details of construction and operation. The author rates high in this particular field so the information is authoritative and conclusive.

$3.65 postpaid

Inventions and Patents

By Milton Wright

THE wide sale of this book attests its authority and standing; no more instructive and understandable text has been written on the subject. Backed by years of experience in the drawing of claims, reconciling interference, prosecution of issue, and protection of rights, no mystery is involved as to why pleased purchasers of this book say it has literally saved them thousands of dollars. It is an unquestioned guide and authority.

$2.65 postpaid, domestic

For Sale by

SCIENTIFIC AMERICAN

24 West 40th Street New York City

Across the Editor's Desk

WE'RE quite aware that the call of the outdoors, of sports, and the like is stronger than the appeal of science right now, but this month we've given you some absorbing features you won't dare pass up and others that will add scientific interest to your vacation trips. Take, for example, Dr. Russell's article on the green flash. Maybe you've never heard of the green flash, but here's your chance to see it—if conditions where you are going are just right—or to see the mirages which he also discusses. They are never-to-be-forgotten sights. During the past year Dr. Russell has been traveling here and there in Europe and the Levant but expects to return to his duties at Princeton soon.

And those insects which you see walking on water while you're in the country—another article tells how they do it. The secret is in the surface film of the water. Now if this surface film were so tough that human beings could emulate the water skipper, how would you like your high diving then? Another article is an "appreciation" of the hoary old man of the meadows: the sycamore; still another warns you to "be careful with fire while in the woods" but it also tells of the extensive system of forest fire protection and fire fighting necessary in this careless country. Summer heat may make you wish that you could, when traveling, sleep in the refrigerated dining car described on page 108, but it just isn't being done. You may dine in such cars soon, however.

"Zoogenesis" doesn't sound like light summer reading but it concerns a subject that concerns all of us: the new theory of evolution. Whichever side you're on, you will want to know this theory. The article was written by Dr. Austin H. Clark, a note about whom you will find on page 87. When his theory was first announced months ago, it was sadly distorted by the newspapers but we went straight to the source and got Dr. Clark's own story.

Unlike the daily press, you know, we don't try to give last minute news just because it is new; we choose our features carefully and then get the man who has made the theory or performed the experiment to write it up for us, but only after it has simmered a bit. "Basic Patents in Evolution," for example, was written by invitation after a member of our staff heard Dr. Gregory give a talk on the subject before the Explorer's Club. By the time he could put into writing the substance of his talk, he was on his way to Africa, and the manuscript of his series was written on the deck of a steamer in the Red Sea.

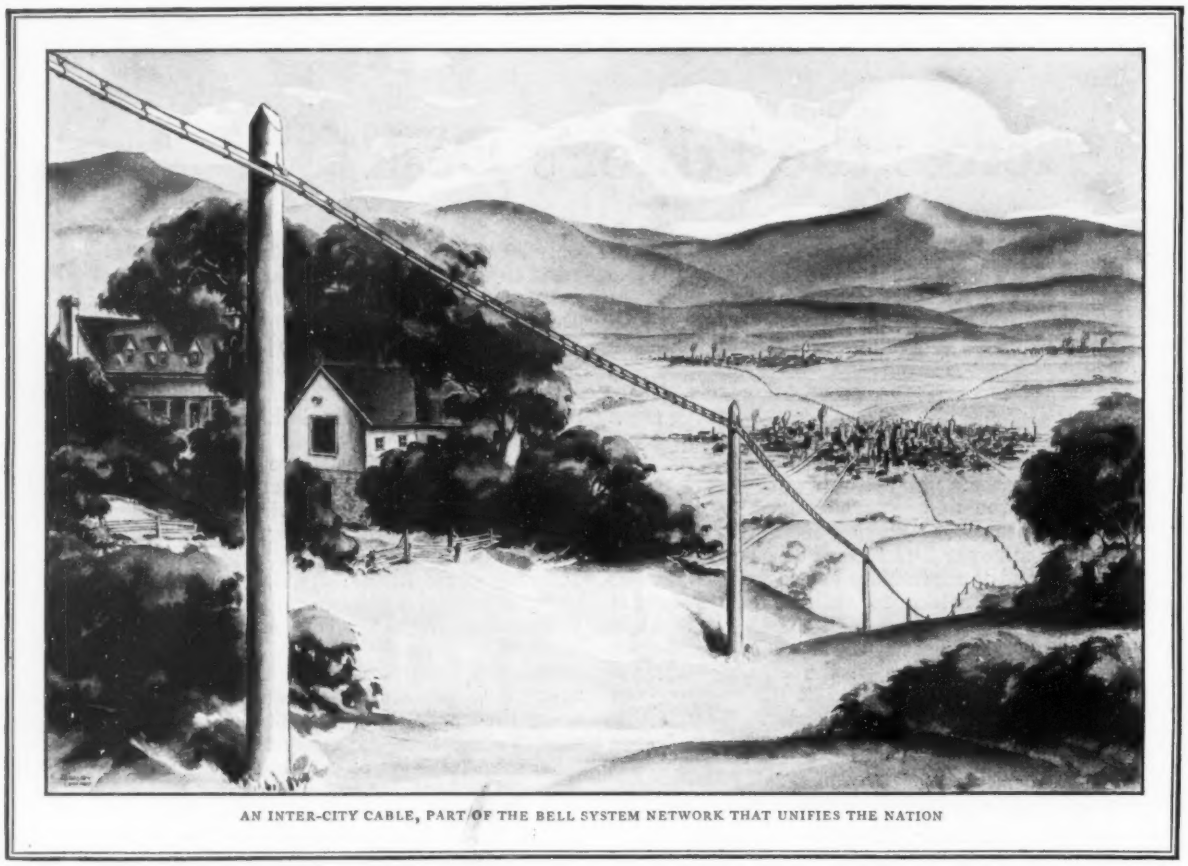
But enough of this. There are other good features in this issue—on the burying of a river in a gigantic sewer, on industrial fatigue by the well-known Dr. Laird, on perfumes, a homemade cheap microscope, and many others—but what of the future? Well, for next month we've scheduled a number of excellent articles.

First of all, there will be one about a subject which has probably puzzled you often: the science of building a railroad. And we warrant that you will be surprised when you learn how many thousands of dollars it takes to lay one mile of shiny rails—so many thousand feet of rails, so many kegs of spikes, so many crossties, and so forth. Another discusses volcanology. As you have surmised, the word simply means the study of volcanoes; and the article is as interesting as volcanoes are mysterious. Dr. Jaggar, who wrote it, has been the next door neighbor of so many volcanoes that he can, and does, let us in on many of their secrets. He now lives and works in a little house on the rim of the crater of Mount Kilauea, Hawaii.

You may expect an absorbing story of the Indianapolis race which was run on May 30. This will cover the scientific aspects and give some of the highlights of the spectacular performance. Water sports come in for their share of space also, for the building of the yachts to defend the America's cup is a highly specialized science. You'll be treated to a story of the races for which these yachts were built.

Of course we can't begin to go into detail regarding all that is to come. The foregoing articles are simply a few samples. There will be others in true SCIENTIFIC AMERICAN style; and that naturally means that your interest was considered when we scheduled them. We hope you'll enjoy them all.

Orson D. Munn



AN INTER-CITY CABLE, PART OF THE BELL SYSTEM NETWORK THAT UNIFIES THE NATION

Vast, to serve the nation . . . personal, to serve you

An Advertisement of the American Telephone and Telegraph Company

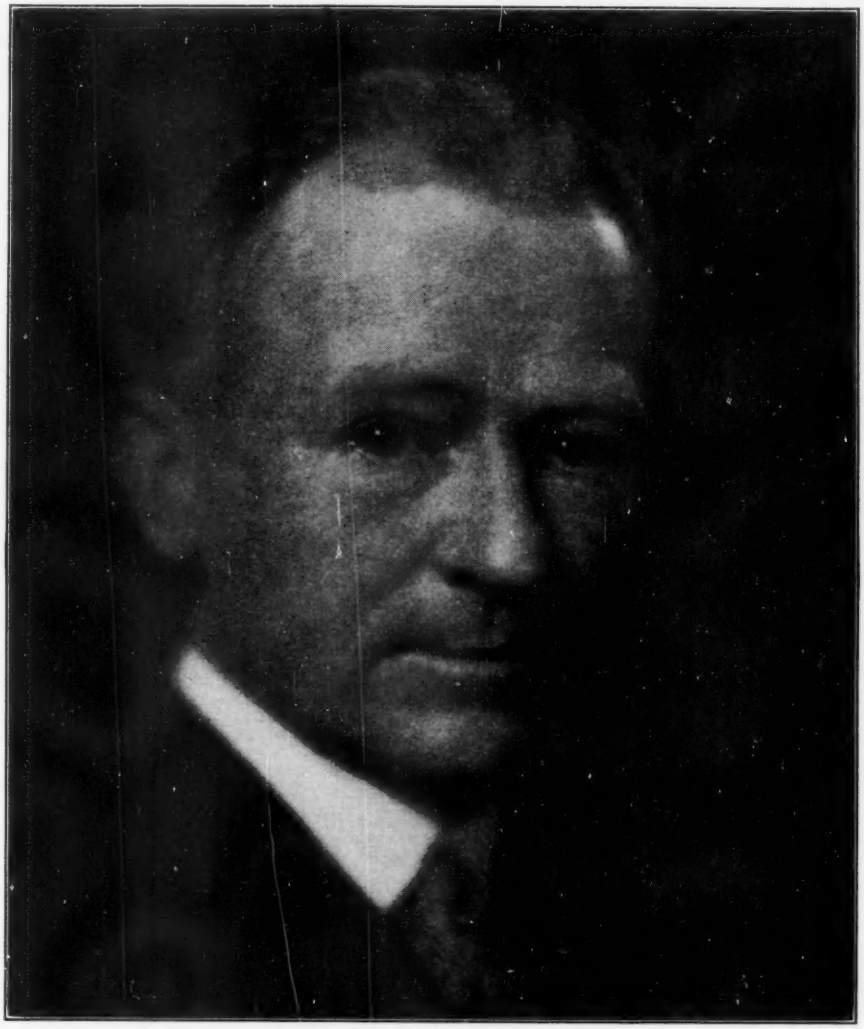
So THAT YOU may telephone from house to house in a Southern village, from farm to farm in the Middle West, or from the Pacific to the Atlantic Coast—the Bell Telephone System *must* be large. Its work is to give adequate telephone service to one of the world's busiest and most widespread nations. There is 4000 million dollars' worth of telephone plant and equipment in the Bell System, any part of which is subject to your call day or night.

Every resource of this system is directed to the end that you may have quick, clear and convenient telephone service.

In order to meet the telephone needs of the country most effectively, the operation of the Bell System is carried on by 24 Associated Companies, each attuned to the area it serves. Working with these companies is the staff of the American Telephone and Telegraph Company, giving them the benefit of its development of better methods.

The Bell Laboratories and the Western Electric Company utilize the talents of thousands of scientists for constant research and improvement in the material means of telephony. Western Electric, with its great plants and warehouses in every part of the country, contributes its specialized ability for the precise and economical manufacture of equipment of the highest quality for the entire system.

The Bell System is vigorously carrying forward its work of improving the telephone service of the country. It is building for today and tomorrow—for the benefit of every one who lives and works in America.



Austin H. Clark

ABOUT a year ago, as many will recall, newspaper accounts, some accurate and some not, concerning a new and rather extraordinary theory of evolution proposed by Dr. Austin H. Clark, widely known zoologist of the United States National Museum, attracted the attention of the scientific world. "Zoogenesis" is the general name Dr. Clark employs to cover his theory about which he has just published a semi-popular work "The New Evolution—Zoogenesis." He also has prepared for this journal the article on the same subject, which starts on page 104. Since the new theory of evolution was announced it has been discovered that Dr. Clark's career in science parallels that of Charles Darwin, the famous proponent of another theory of evolution which has made history. Like Darwin, Clark never was a "closet student"; for 30 years he has traveled widely and observed actual things in Nature. Both scientists spent many years studying at first hand a wider scope of material than the average zoologist finds accessible. Clark specialized in the study of birds and insects and then, to enlarge his point of view still more, he spent some years specializing in oceanography—as did Darwin. Both also made long cruises on specially equipped sea vessels, Darwin on the *Beagle*, Clark on the *Albatross*. Only after so catholic a study of the interrelationships of the different forms of animal life can a man of science feel equipped to synthesize a broad theory such as Clark's theory of evolution—Zoogenesis.

Courtesy of The Logan Museum, Beloit College

Halvor L. Skavlem

MORE expert at flint flaking than any of the living Indians, who have wholly forgotten the art, Mr. Skavlem, son of a pioneer Norwegian family of Wisconsin, can duplicate early Indian flint artifacts so skilfully that no one in a test has been able consistently to distinguish the two. Mr. Skavlem, now 84, continues to make artifacts at his summer home at Lake Koshkonong, Wisconsin, his motive being a scientific interest in the art. He has clearly exploded the previous notion that it was a "secret" and a "mystery," and proved that the white man of normal manual dexterity can learn to perform it as neatly as the red man. Alonzo Pond, the well known anthropologist of Beloit College, has described his work in a book.

The fighting front line. Bringing up a hose from a water tank

Fire: the Enemy of Our Forests

By CHARLES W. GEIGER and WALLACE HUTCHINSON

PERCHED on the top of a rugged mountain peak stands a small square house with steep sloping roof to shed the heavy winter snows, and with long windows on all four sides. From this elevated lookout point during the fire season, sharp-eyed sentinels scan the vast expanse of green forests stretched on all sides below them, searching, always searching for the telltale wisp of smoke that marks the newly started forest fire.

This scene, common enough in the great forested areas of the west is somewhat rare in the east, but the disastrous fires of the past spring have brought home to many people the fact that the east needs many more lookouts. In the west a forest fire as a rule rages through woods without endangering very many habitations; in the east many farms and villages have been wiped out by fires that began in the forests. In either case, the monetary loss often runs into millions of dollars and yet it is a strange trait of human nature that very little thought is given to forest-fire prevention, and it has always been difficult to obtain appropriations necessary for such work.

OUR forests are one of our greatest natural resources. They furnish a playground for thousands of vacationists and nature lovers and are the storehouse of waters that feed our lakes and rivers which make year 'round hydro-electric power possible. They furnish lumber, pulp for our paper, and many other necessities of life. The people of the United States use in house-building and otherwise, two fifths of all the wood consumed in the world. To perpetuate the source of supply, federal and state governments are practicing reforestation and have expended every effort to save our forests from the fire menace. In carrying out this huge task the most modern equipment is used whenever possible.

The guard may report a fire by either telephone or heliograph

In cities and towns fires are usually discovered shortly after breaking out. In the mountains, however, extensive areas of our forests are so thinly populated and afford such obstructed views because of mountain ranges and deep canyons, that fires might become very large before they were discovered if some special means of detection were not employed.

IN California and many other states, a careful watch is maintained over forested areas by United States Forest Service men stationed on high peaks, who act as fire lookouts, and by fire guards or patrolmen who travel along ridges and other routes where they have a good view of areas in which fires are likely to occur. The lookout men go to their stations in the high mountains early in the summer and remain constantly on duty, from daylight to dark, until the first rains come in the fall. Food supplies and mail are sent to them by the rangers. These lookout men occupy small buildings or observatories with windows on all sides. Many of these houses are set on steel towers 30 to 60 feet above the ground, so that the lookout man can see over the surrounding trees or other obstructions. In addition to the fire lookouts, everyone within or near the forests (miners, stockmen, hunters, campers, motorists) is constantly on the watch for any fires that may occur.

Fire fighters on their way to a fire, carrying their tools

Throughout the Pacific coast states, in addition to lookouts, airplanes are used to discover fires. A man in an airplane flying at 5000 to 10,000 feet above the ground can look down upon a wide expanse of country and quickly detect the smoke of a small fire which may be hidden by mountains or forests from the lookout men. The airplane, however, does not fly daily over the forest. It is used largely as a scout for making air surveys of large fires that are burning, in order that the forest officers may know how best to fight them, and for forest patrol after lightning storms and during hazy or smoky weather. Under such conditions the airplane is a valuable aid in forest protection.

AT the side of the lookout in the tower mentioned in the first paragraph, stands a telephone, one of the nerve ends of the efficient system of telephone communication lines that play such an important part in combating the fire menace in our great national and state forests. There are other instruments of the magneto type located at intervals along the forest trails and roads. These latter telephones enable the forest guards to keep in touch with the central ranger station at all times.

If the guard discovers a fire, he goes to the nearest telephone, calls the ranger station, and reports the location and the extent of the fire. Men with fire fighting equipment are immediately dispatched to the scene of action and if the fire is likely to assume large proportions, one or more fire camps may be established. Temporary telephone lines are quickly stretched between these camps and the central station so that the men engaged in fighting the fire may keep in constant touch with the supply base to report progress and order more men, food, or equipment.

In districts where it would be impracticable to maintain a permanent fire fighting force, volunteer fire fighting units have been established under the direction of a fire leader. This man designates an individual to act as local "dispatcher" whose duty it is to take care of the lines of communication during a fire.

Fire fighting tools stored on the trail ready for future use

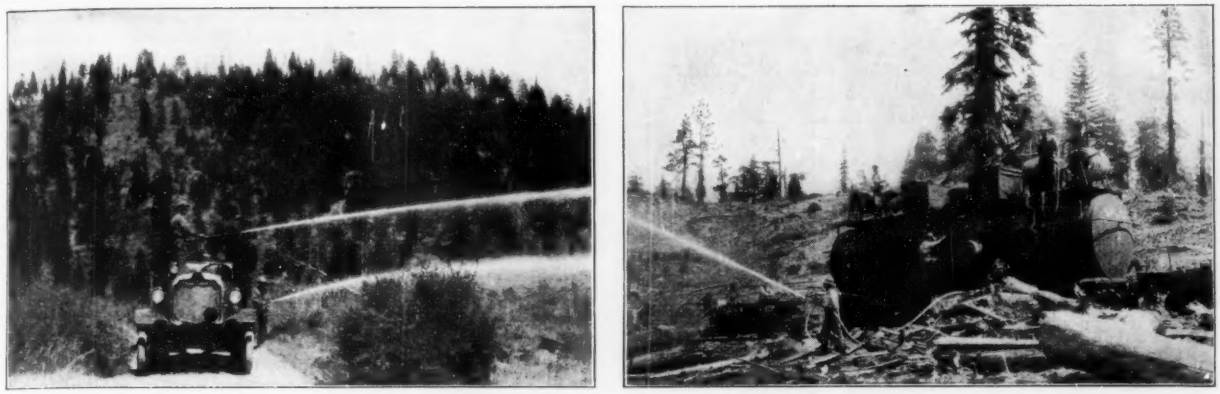
SINCE forest fire prevention is so largely dependent upon telephone communication, forest rangers must be efficient linemen. A course in telephone construction and maintenance is given each ranger during the training period and he is furnished with a manual giving specifications and details of telephone line construction. This construction is unique because it would be difficult to construct a pole line in thick timber, high underbrush, and rocky ground. Therefore, lines are strung along on trees, usually following trails or paths. In brush country where fire damage to wooden poles would be heavy, iron tubing is used.

Before the beginning of the fire season a careful check is made on the communication system and the damage done by weather during the winter months is repaired. Thereafter, all lines are tested daily. Most of the forests are situated in high altitudes and the forces of nature combine to make this job of maintaining perfect communication more difficult. It is said that over 1500 telephones directly constitute the service of communication between the extensive system of forest protection in California alone.

In a few localities where there are no telephone lines, the heliograph is used. This instrument sends messages

A camp in the path of the flames

Advancing to meet the roaring enemy



A water tank on a motor truck and a railroad tank car

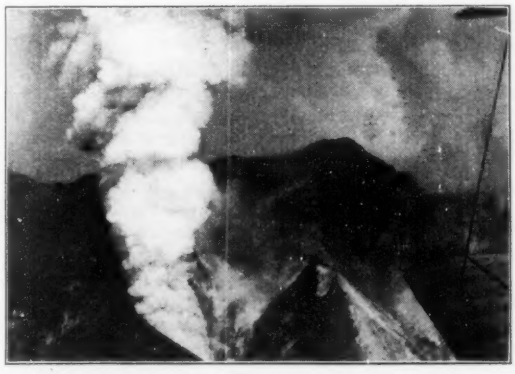
in telegraphic code by means of a small mirror which reflects the sun's rays. This method is therefore valueless in cloudy weather, or when the sun is obscured by the haze and smoke from a fire.

Inasmuch as weather conditions have much to do with the prevalence of forest fires, an intensive fire-weather service has been in operation in California since July, 1926. The principal object of this service is to aid all fire prevention and suppression agencies in their efforts to reduce losses from forest, grass, grain, and brush fires. This fire-weather service works in close co-operation with fire-agencies, federal, state and private.

THE term "fire-weather" aptly describes those combinations of weather conditions which cause fires or which favor their rapid spread when once started. Lightning, for example, causes as high as 45 percent of all the outdoor fires in California, depending upon the season. Severe lightning concentrations in the state have caused more than 350 lightning fires in national forests during a single thunderstorm period of two and a half days.

Hot, dry, windy weather constitutes the fire-spreading phase of fire-weather. Thus a knowledge of atmospheric relative humidity, and of wind direction and velocity, have a very important bearing upon both fire prevention and fire fighting work.

The service rendered by the Weather Bureau is primarily a forecast service. Systematic fire-weather forecasts are issued by the district forecaster of the Weather Bureau at San Francisco based on the usual synoptic weather reports and charts, supplemented by daily telegraphic reports from especially established fire-weather observing stations in various areas in the state.



Airplane view of a fire in a distant canyon

The fire-weather forecasting unit which travels throughout the state of California during the fire season and gives information to aid in fighting fires

Since fires and their complex topographical surroundings cannot be taken to the district forecast center for analysis, a mobile weather bureau office has been provided to take equipment and a meteorologist to the fires. This unit consists of a motor truck equipped with meteorological instruments including anemometers, hygrothermographs, psychrometers, maximum and minimum thermometers, rain gage, and a small aneroid barometer as well as radio receiving instruments to catch the detailed weather reports which are broadcast twice daily from the naval radio station at Mare Island. The truck has accommodations for two men who will operate it, one a meteorologist in charge and the other a combination observer and radio operator.

Traveling throughout the state during the fire season, the unit proceeds immediately to a large going fire upon receipt of telegraphic orders. Radio apparatus is set up and temporary check or key weather stations are established in the fire vicinity. These stations issue detailed forecasts of all weather conditions influencing the choice of fire tactics and the ultimate control of the fire. Such forecasts are issued twice daily together with any special advice that may be required in connection with back-firing and similar operations.

PREPARATIONS for the fire season are quite elaborate. Before the season opens, an ample supply of fire fighting equipment is distributed to points where it will most likely be needed. This equipment consists of axes, shovels, rakes, hoes, canteens, cooking utensils, and emergency food rations.

During the summer months the rangers are assisted by guards, patrolmen, and firemen, but they also make arrangements with nearby merchants,

The contrast of beauty and stark ugliness of a skeleton forest made by fire: two views of the same location. Perhaps carelessness was the cause

ranchers, and others for supplies of laborers, transportation, and food in case of emergency.

When a fire is reported, the forest ranger or one of his assistants may go to it alone if it is very small. For a larger fire, three or four men with rations for two days may be sent. If the report indicates that the fire is likely to become a big one, a large number of men, with the necessary tools, are gathered and sent to the fire. Food, supplies, and further equipment follow by slower transportation because the rangers continue fighting the fire until it is completely out and do not waste time in going back and forth for food, bedding, and tools.

Small fires in grass and forest litter can often be beaten out with branches or wet sacks, but if burning fiercely it is usually necessary to clear a wide fire line which the flames cannot cross, some distance in advance of the fire. Sometimes back-firing is necessary to control big fires. In back-firing, a fire is built in advance of the main fire, usually along a road, trail, or other suitable place where it can be properly controlled; and it is allowed to burn back toward the main fire. When these two fires meet they die out for lack of further inflammable material. Since back-firing itself is dangerous if not properly handled, only experienced fire fighters should employ it.

In all fire fighting, advantage must be taken of natural conditions. A fire may burn very rapidly up steep canyon sides, but may be stopped easily at the top of the ridge. Fires usually die down during the night and the best time for fighting them is immediately after daybreak when relative humidity is high.

In many cases the fire-fighting equipment is supplemented by water tank pumping trucks if highways run through timber lands susceptible to fires. In many cases also, railroads have built special tank cars with necessary pumping equipment for fighting forest fires along their rights of way.

Although a large percentage of forest fires are started by lightning, a greater number are caused by the careless use of fire by tourists, campers, hunters, and fishermen. Many people know, either from actual experience or hearsay, the havoc that fires play in our forests each year; they know the necessity for precaution in using fire for any purpose in forests, but strangely, as has been noted, carelessness still seems to be the predominant characteristic of many people when they are in the woods.

Nothing betrays the tenderfoot sooner than his fire. The woodsman, before he builds a fire, clears a space of all grass, leaves, and trash, digs a small hole, and in it builds a small, quick fire. When the fire burns down he sits beside it and does his cooking. The tenderfoot, on the other hand, makes a bonfire and cooks himself while he burns his food. A woodsman never builds a fire near leafy trees, dead logs, or underbrush; nor does he build bonfires in windy weather where there is the slightest danger of the fire becoming uncontrollable.

HE never leaves camp even for a short time without first putting his fire out with plenty of water and then covering it with earth. He is always a careful smoker. He breaks his match in two pieces to make sure that it is out before he throws it away and stamps with his foot every spark in discarded pipe heels, and cigar and cigarette stubs. Many voluntarily refrain from smoking in the woods during the dry season.

Someone once said that if we could educate every American to be careful with fire, 95 percent of our national forestry problem would be solved. In closing, therefore, we shall repeat a few rules which, if followed, will aid greatly in the solution of the forest fire problem: 1, Build camp fires like those of the woodsman; 2, Be sure the camp fire is entirely out before you leave it. Be sure that matches, cigars, cigarettes, and pipe heels are out before being discarded; 3, If you discover a small fire, put it out. If it is too large for you to handle, go to the nearest telephone and notify the ranger, local dispatcher, or whomever else may be directly concerned in your particular locality and then stand by until help comes.

The woodsman is never careless with fire. He builds his campfire in a hole in the ground in the middle of a cleared space; and when he leaves, he first drenches it thoroughly with water and then covers the ashes with plenty of soil

OUR POINT OF VIEW

The Improved Patent Situation

INVENTORS who have for years been led to believe that it must take an unconscionably long time to obtain a patent, have in store for them a pleasant surprise. A keen note of optimism is now heard wherever one goes regarding the situation in the Patent Office, for things have happened there.

Admittedly, the Patent Office has had a steadily increasing file of unfinished business, patent applications that must await their turn. At the present time, it is farther behind in its work than ever, but this is partly because of the curious fact that more free-lance inventors seek patents during periods of unemployment than at any other time. But even in normal times, the majority of delays in the granting of patents are due to the fact that inventors or their attorneys exercise their statutory right to delay, for various reasons of their own, their answers to official actions of the Patent Office. The Commissioner has been diligent in his supervision and is not to be blamed when he has such conditions to face and especially when his office has been functioning under the handicaps of inadequate facilities, an inadequate examining force, and inadequate salaries for the examiners. The salary question alone has worked a great hardship on the Patent Office for years, for the examiners were never paid as much as they could command in outside practice. As a result of this, there has been a large turn-over in personnel, and new men were constantly being taken on and put through a training period that was largely unproductive.

The situation has changed. Some time ago, Congress authorized salary increases all along the line and also gave authorization to augment the force of examiners. The salary increases went into effect January 1, and the extra examiners, totaling 110 men, were on the job July 1. The examining corps now totals 708 and the total professional force 722. Members of the patent bar worked with the Patent Office for years to bring about these changes, and when final consideration was being given them, they had the unqualified support of the President, Congress, and the Budget.

An Assistant Examiner now starts at 2000 dollars yearly, a very good salary, we should say, for a man just out of college and especially in Washington where this amount is equal to 3000 dollars in most other large cities. This new man can go to 3700 dollars before he takes the next step upward to become Assistant Chief Examiner, with a fine salary increase. Then comes the Principal Examiner, head of a standard examining division of which there are 63, who now gets a larger salary than did Mr. Robertson when he became Commissioner. Still higher in the salary scale are the Assistant Commissioners and the Members of the Board of Appeals, one more of the former and three more of the latter having been included in the recent authorization to enlarge the force.

The larger force is going to improve the patent situation greatly, and the salary increase has already shown its effect in improving the *esprit de corps* of the Office to such an extent that it is felt that there will be an increasingly smaller turn-over in personnel. Besides this, further hope for the betterment of the situation is seen in the fact that within the year, the Patent Office will have moved to its larger, more modern quarters in the Department of Commerce Building, now under construction.

Commissioner Robertson has done much to bolster up the Patent Office and is to be commended for his part in bringing about the changes. Because of them, the Patent Office may be expected to act upon patent applications with more expedition than has heretofore been possible. In but a short time, therefore, we feel that the situation will begin to clear up; but in the meantime, we urge upon inventors a little patience, a spirit of cooperation, and promptness in replying to official communications; and upon critics of the Patent Office, more judgment in analyzing the situation.

Sir Henry Segrave

SPEED mania has again taken its toll. This time it was Sir Henry Segrave who, piloting *Miss England II* on Lake Windermere in England, had just made a record run at over 98 miles an hour and was on a second trial run when his powerful boat swerved, somersaulted, and capsized. Sir Henry was to have entered the boat in the Harmsworth Cup races in the Detroit River August 29 to September 2.

While we still do not feel that the end justifies the means in these attempts at world speed records, we do not wish to detract from Sir Henry's reputation as a man of high and dauntless courage. Those who knew him, the entire sporting world, the automotive industry for which he performed invaluable service, and many others in high places who knew him as a gentleman as well as a sportsman of the highest type, have all been shocked and saddened by his death. His was the breed of daring that feared more to fail in what he set out to do than any physical hazards he had to face. We offer our sincere condolences to his family and to his country.

Returning Prosperity

CURIOUSLY, last fall's stock market break did not mark the downfall of the capitalistic United States, as the small group in control of the Soviet so hopefully predicted. Of course we wouldn't think of suggesting that the prophets played too loosely with an idea—for they are very *wise*—but something happened to nullify their opinions. This capitalistic country which "bled its people dry" will soon be back at its old tricks of making and spending money and enjoying prosperity. We're sure of it!

Business has been down for an unprecedentedly long time now. An article in a bulletin of The National City Bank of New York, however, states that: "During the period of curtailed production, consumption has gone on—in somewhat reduced volume, it is true, but nevertheless at a rate in excess of production—so that it is only a question of time until shortages will begin to develop and necessitate the speeding up of the productive machine." In other periods of depression, the business of the country was far less diversified and lacked the recuperative power demonstrated in recent years. With the present easy money and "with the record of past depressions so suggestive of the country's ability to regain its stride, there seems reason for confidence that business will soon begin the climb back to normal prosperity."

Almost everywhere we hear the same opinion expressed, sense the same feeling of hopefulness. With everybody thus "tugging at the wheel," we are sure that boom days are not far in the offing. Perhaps our Soviet ill-wishers won't like to hear this but then, once *they* have a taste of prosperity—the success of some of their programs—doubtless they will feel less envious.

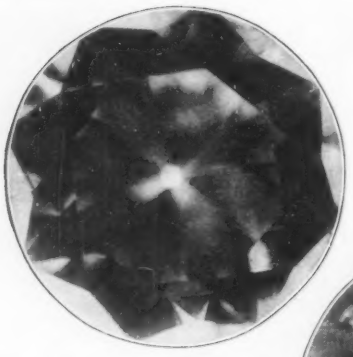
Navies and World Problems

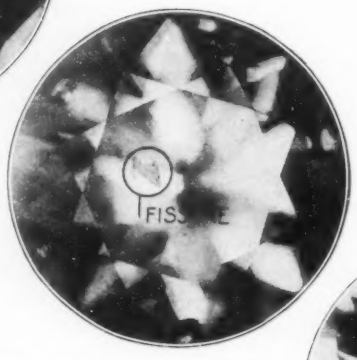
WE still believe the treaty should be ratified, in spite of the very positive handicap it places on our Navy; and we believe there would have been less opposition to it from the press and the people if the Adminis-

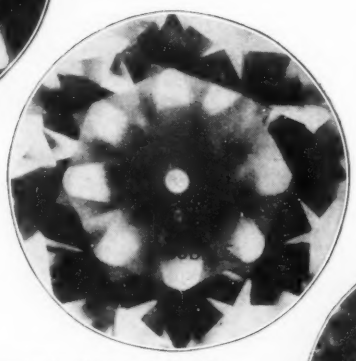
(*Please turn to page* 153)

Photography Identifies Gems by Their Flaws

By FRANK HEITZLER







The diamond is apt to have defects such as irregularities in cutting, incipient fractures and imperfections in crystallization, included bubbles of air or gases, and specks or flakes of metallic oxides or carbon. *Above:* photograph of a perfect stone

THE diamond is always recognized as the chief among precious stones. It is the hardest and most brilliant of minerals, but it is a curious fact that the artisan is necessary to develop nature's raw product, for there is no indication of beauty until it has been faceted and polished by the hand of man. Nature does not always give us a perfect product and, even when polished, the diamond is no exception to this rule. Ninety-six percent of the stones found are more or less marked with imperfections in their creation, and as there are no two stones exactly alike, these flaws can be used for the purpose of identification by recording them, superimposed on a photographic plate. Stones without obvious imperfections can be recognized and identified by their shape, cut, color, and weight.

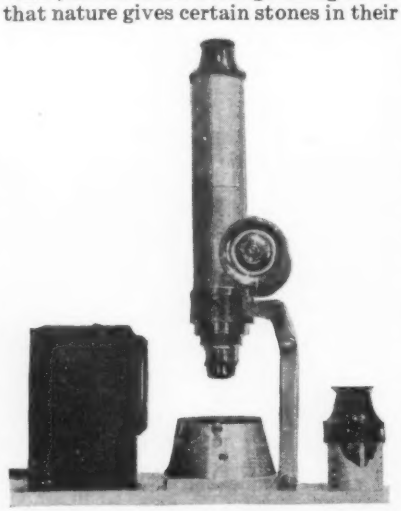
Imperfections or flaws in diamonds are classified in the following way:

FIRST, there are the carbon spots which may appear as a single defect or in a group. If very fine and located toward the edge of the stone, their interference with reflection is not great, but if located toward the center of the table of the gem they will prevent the colors from striking through, and consequently will depreciate the stone.

Next there are discolorations in the optical homogeneity of the stone. These may appear milky or brownish in hue, or like fine gravel. They are named "faulty structure" and are very depreciating to a stone. Another defect is the presence of bubbles; they are often filled with water or gas. As they are transparent, they do not cause any appreciable obstruction to the spectrum of colors, if not too large in size. Very fine fissures are not very detrimental, if they do not run across the table of stone, and often cannot be seen by a jeweler's glass. "Feathers" appearing on the table of a stone do not exactly improve its appearance, although they are not as detrimental as carbon spots.

Colors are ascertained through a low-powered microscope equipped with a polarizer and analyzer, intensified by a selenite plate. The operation is speedy and absolutely certain as the lens system shows the colors as they are actually present, not omitting the slightest hue. Color is the predominating factor which gives the stone its value, and it is the distinguishing favor that nature gives certain stones in their making. No cutting of facets can produce the brilliancy and wonderful display of colors imparted when rare minerals are molten in Nature's manufacture of the diamond.

It is a foregone conclusion that identification photographs of diamonds do not constitute a "beauty contest," as their purpose is to show all imperfections to the smallest detail no matter where located, as clearly as is possible with a modern scientific system of lenses.



Folding microscope for the use of detectives who constantly search pawnshops for stolen jewels

Thus it will be possible to duplicate the photographs 10 or 20 years hence, and to produce them in court as proof of ownership. In the system for identification of diamonds, the slip attached to each photograph always states size of apparatus and kind of lens used, as well as the depth of imperfections and their character.

The colors of diamonds are governing factors in obtaining a good picture. A perfectly white stone photographs an even color and the blue, greenish white, and pink tints are not so bad. However, red and yellow are two interfering colors which no filter will overcome. The reason for this is that although a filter may prevent one color from affecting the plate, the filter itself reflects back to the stone, producing another color which is usually worse than the one it prevented from coming through. In order to overcome this mixed color effect to some extent, specially prepared emulsion plates are used.

The illustrations show the equipment used; important factors are the different holders constructed so that

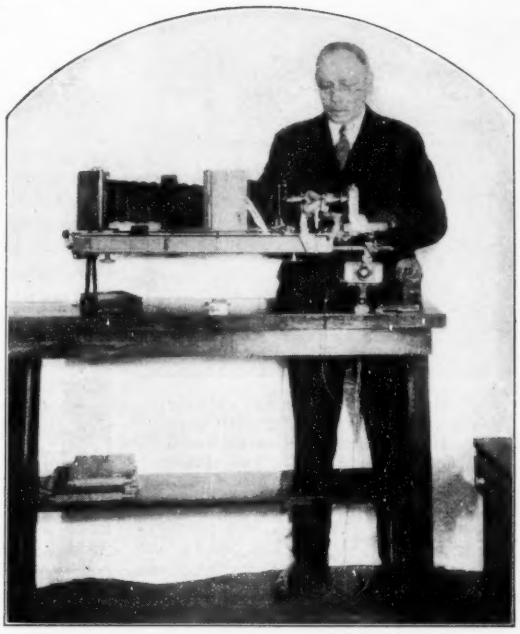
rings or stones cannot be jarred out of position while operating the apparatus. The slide which carries the lens must be a perfect fit, otherwise moving it will shift the image. The camera is of the photomicrograph type with a 42-inch bellows.

The magnification used depends entirely upon the experience of the operator. An attempt to employ too much magnification will distort the outlines of the stone, making it unsightly on account of the manifold reflections of the cut and the facets of the stone. Medium or high-power lenses are useless as the index of refraction and curve of the lens produces an interfering color. Therefore a Micro No. 1 lens is used, and the stone is inserted in the holder, after cleaning it carefully. The lens is then focused and the image appears. The back of the camera is provided with a mask having a circular opening about 3½ inches in diameter, which is placed very close to the plate. The image of the stone has to be centered by simple mechanical movements so that it fits perfectly in the mask. This is all done from the back of the camera where the operator is seated.

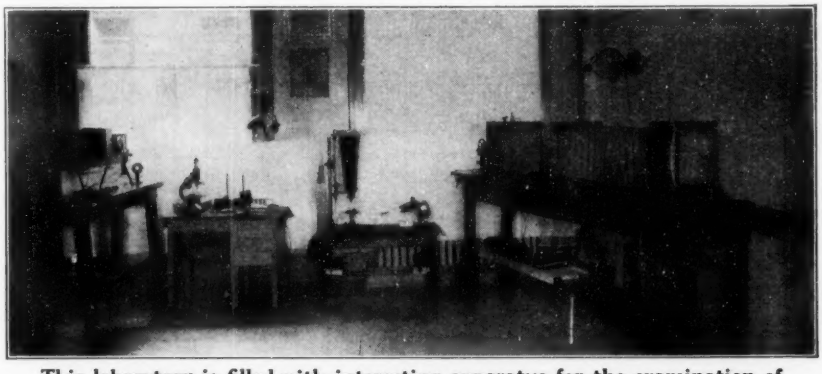
TO eliminate differences in exposure due to changing daylight and to take pictures at any time, a constant-intensity electric light is used, operated by a 6- to 8-volt source. The lamp is placed in back of the stone. The condenser lens and reflector are made in such a manner as to keep the rays of light from the lens proper, confining the pencil of light to the diamond. For rubies, sapphires, and emeralds, two lamps are placed in front of the stone to give the darker stones the proper illumination. The same method is also used for settings which have no back opening or insufficient space. The time of exposure for mounted stones is from 6 to 10 seconds, and for loose stones, from 2 to 3 seconds.

After the gem is securely mounted, and the lamp turned on, the next operation is to set the micrometer to zero. This micrometer is an important feature, and is attached on the back of the camera. A rod connects the lens slide and the micrometer. The lens focuses sharply on the table of the stone, the hand of the micrometer reads zero, and the search for characteristic imperfections begins. The lens is moved toward the interior of the stone, and the depth of any flaws appearing in a certain plane is read off on the micrometer and noted. This searching is continued until the end of the stone is sharply defined. Turning backwards to the table, focusing sharp, the plate is inserted. The first exposure is of the table; second, the first imperfections as indicated by the micrometer reading. If a third exposure is necessary, all three are superimposed on the same plate.

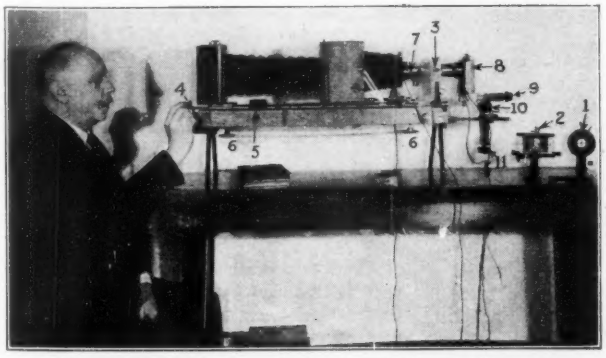
After prints have been made, a written record is attached for further reference, the negative and the record are numbered and filed, and in case of theft, prints are made and distributed to police, jewelers, and pawn shops. If a very valuable stone, the photograph can be radiographed to foreign countries thus quickly closing to the thief all possible markets for his ill-gotten treasure.



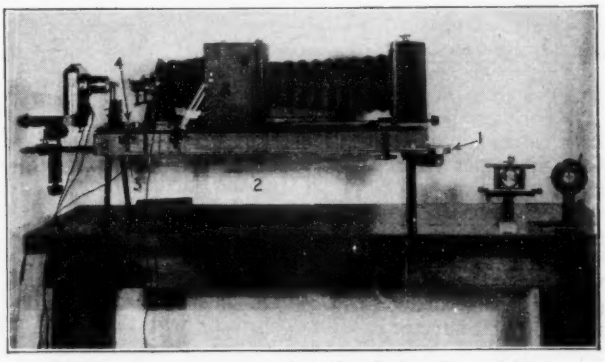
The photomicrographic apparatus in the author's laboratory used to examine gems



This laboratory is filled with interesting apparatus for the examination of diamonds and other precious stones by the means described in the article



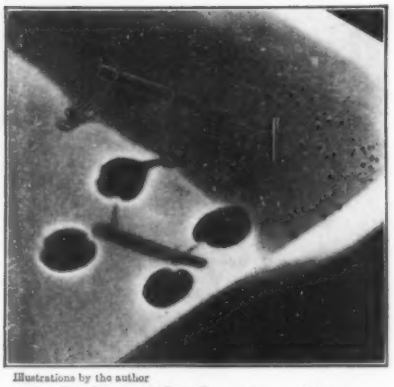
Where the stones are focused and the readings taken. After the gem is securely mounted and the lamp turned on the micrometer is set at zero and the search for imperfections begins. In the left-hand illustration *1* is the holder for loose stones; *2* and *3* are holders for rings; *4* is the lateral adjustment for holder; *5* is



the focusing arrangement; *6* is the device for raising and lowering lens; *7* and *8* are lamps; *9* the condenser adjustment; *10* and *11*, adjustments for light. In the right-hand illustration is the back view. *1* is the micrometer; *2* is the connecting rod; *3* the lever arrangement; and *4* the connecting pin to lens slide

Walking On Water

By HENRY J. TOMLINSON, B.Sc.



Illustrations by the author

A little artificial water skipper made of a match stick, with tiny wire legs waxed at the bottom, will float on the surface of water

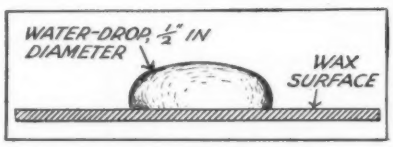
IF we stroll in the country by a pond on a summer's day, the chances are we shall see insects moving on its surface; some of them, such as whirligig beetles, are swimming, but others, for example the so-called water skippers or pond-skaters, are actually walking on the water. This is in itself a most interesting thing, but there is something else well worthy of attention.

If the sun be shining brightly, a number of little shadows will be seen on the bottom of the pond. Each of these corresponds to a foot of a water skipper, or some other insect walking on the water surface. Each is surrounded by a narrow, bright halo of light, reminding one of a tiny dark cloud with a silver lining. At the top is a photograph showing such shadows, together with their halos. How comes it that some insects can walk on water, and what is the explanation of the beautiful little shadows and their attendant halos? When a liquid is brought into contact with a solid, the liquid in certain cases is said to "wet" the solid, while in others it is said not to do so. To the non-scientific mind this would seem strange, as naturally one would expect a solid to be wetted when in contact with any liquid. It is, of course, all a matter of definition, and a simple experiment will make the point quite clear.

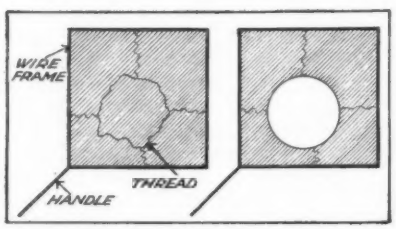
LET a drop of water be placed on a horizontal sheet of glass which has been cleaned and repeatedly scrubbed with nitric acid, and is perfectly free from grease. It will be found that the water spreads in all directions over the glass. Now let the glass be coated with a thin layer of melted candle-wax which is allowed to solidify. If a small quantity of water be placed on the solid wax surface it will not spread as in the previous case, but will gather up into a drop, the shape of which depends on the quantity of water taken; one such drop is shown at the right. The clean glass surface is wetted but the wax surface is not wetted by the water, in the scientific sense. In the same sense, the clean glass surface is not wetted by mercury since the latter, when placed on it, collects into drops.

The surface layer of every liquid behaves in many, though not all, ways as if it were a very thin *stretched* elastic skin; that is, an elastic skin under tension. Of course, the surface layer does not differ in chemical properties from the rest of the liquid, but it behaves in a different way.

A very thin, stretched, horizontal sheet of rubber will serve as a rough model indicating the behavior of the surface "skin" of any liquid. One property of the stretched rubber sheet is its tendency to shrink again, and it is evident that it will do so if the stretching force be removed. The following experiment shows that a liquid surface has the same tendency.



A drop of water on the waxed surface of glass remains heaped up



An interesting experiment made with silk threads and soapy water

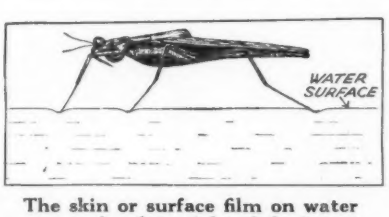
Above, at the left, is represented a wire frame to which a loop of very fine unspun silk has been attached, by means of four tethering threads of the same material. If the frame be dipped into soap-solution, such as is used for blowing bubbles, and then removed, it will be found to have a soap film stretched over it, indicated in the figure by the shading. In this film the silk loop floats. The film has two surfaces, just as a sheet of paper has, and each surface is tending to shrink. If now the portion of the film *inside the loop only* be broken by touching it with the end of a hot wire, the remaining film will pull the loop into the form of a true circle, as shown at the right. The reason is that the remaining film shrinks to its smallest possible dimensions, and in doing so it obviously pulls the loop into that shape for which the area inside it is the greatest possible—the circular one.

Returning now to the model of the stretched rubber sheet, imagine a mouse to be walking on it. The rubber will sag under the feet of the mouse, just as a tight-rope sags under the performer. In a similar way, the surface "skin" of water sags under the feet of a water skipper. In fact a tiny hollow or dimple is made in the surface under each foot, as indicated in the drawing below (not intended to be accurate in detail), and this sagging enables the weight of the insect to be supported.

IT is absolutely necessary that the nature of the insect's feet should be such that they are not wetted by water, for if they were the water would spread over them. In this case, the feet would go through the surface layer and walking on it would be impossible.

Another figure shows, on an enlarged scale, how one of the dimples mentioned can be used to explain the formation of the shadows and halos on the bottom of the pond. The black object indicates the insect's foot. For simplicity it is drawn as a vertical stump, after the manner of a wooden leg. Also for simplicity, all the rays of light falling on the water, represented by lines with arrow heads on them, are taken as being perpendicular to the undisturbed surface of the pond.

When a ray of light, for example *AB*, strikes the water surface perpendicularly, it passes into the water without any bending or deviation. But when it strikes the surface obliquely, as in the case of the ray *CD*, it is bent on entering the water and takes the path *DE*. The amount of bending depends on the magnitude of the angle which the ray makes with the surface, and if the paths



The skin or surface film on water sags under the weight of the insect

of the various bent rays to the left of the central line *FG* be traced, it will be found that they are all tangential to a certain curve *HJK;* an exactly similar and symmetrical arrangement holds good for the bent rays to the right of *FG*.

Now let the bottom of the pond be represented by the line *LM*, and con-

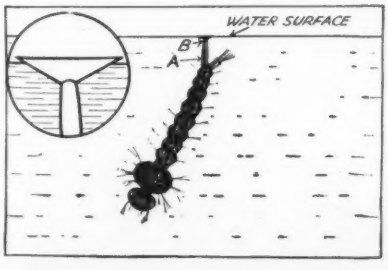
sider the narrow beam of light *NP*, which is shaded in the figure. It will be seen that this beam, after entering the water, comes to a focus at the point *J*. Consequently *J* is a bright point on the bottom of the pond, and, for the same reason, *Q* is a bright point too. No light rays fall on the bottom of the pond between the points *J* and *Q*. Therefore all points between *J* and *Q* are dark; in fact *JQ* corresponds to the shadow.

As the figure shows only the rays in the plane of the paper, it is necessary, in order to obtain the explanation of what occurs in nature, to imagine the figure to revolve about the line *FG* as an axis. The bright points *J* and *Q* then travel 'round a circle so that, when we take into account all possible rays and not merely those in the plane of the paper, we see that there is a bright circle on the bottom of the pond. This is the halo to the dark circular shadow of diameter *JQ*. The rest of the bottom of the pond, illuminated by such rays as *AB*, is bright, but not so bright as the halo, owing to absence of focusing of the rays.

IT is interesting to observe that the diameter *JQ* of the shadow is greater than that of the stump representing the insect's foot. Also, if we imagine the bottom of the pond to be transferred to the level of the line *RS*, so that the water is now deeper than before, the halo will be produced by such beams of light as *TW*, which comes to a focus at *K*, the diameter of the shadow being *KY*, and therefore greater than in the previous case. Thus the deeper the pond, within limits, the greater is the size of the shadow.

In nature the shadows are not circular, but of an irregular oval form, owing to the shape of an insect's foot differing from that of the stump shown in the figure.

No doubt many readers will like to know how to produce the shadows artificially by means of a little model which takes the place of the living insect. This model, which is made from a match-stick and very thin wire, is shown at the right, its total height being about three eighths of an inch. To prevent the wire feet from being wetted by water, they must be coated with little masses of wax.



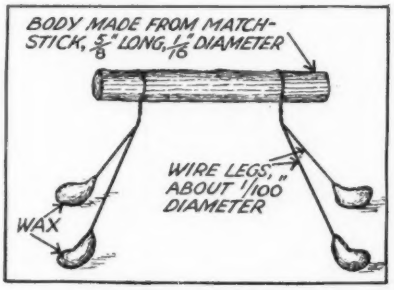
How mosquito larvae breathe. Inset: magnified breathing tube

The model will stand on water, provided it has the dimensions given, and if the bottom of the containing vessel be white, it will show very clearly the shadows and their halos when a bright source of light such as an electric lamp (in the absence of sunlight) is placed directly above it. One figure shows the corner of a white dish containing water, in which air bubbles can plainly be seen. The model, with body blackened, is standing on the water.

As wax floats on water, it may be thought that the wood and wire are buoyed up by the little masses of wax and that therefore the weight of the model is not supported by the water skin; in other words, that the model is not really standing on the water. Any doubt on this point can be removed by completely immersing the model, when it will be found to sink.

So far, we have considered insects moving on the upper side of the "surface" skin of water, but pond-snails can hang from, and crawl on, its underside, somewhat in the same way as a fly can walk on a ceiling.

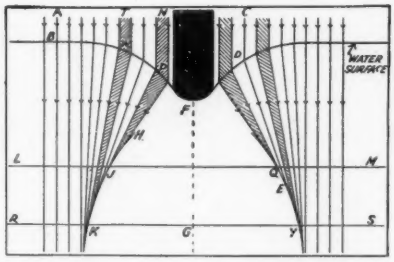
The power of hanging from the surface layer is of great importance to mosquitoes. These insects in their larval stage, which corresponds to the caterpillar stage of a butterfly, live in water and can be found in summer in almost any place where water collects.



How the synthetic water skipper described in the article is made

A drawing of the curious looking larva of one species of mosquito is shown enlarged below at left. The side tube *A* is used for breathing purposes and five little plates are hinged to the end of it at B. When the larva is wriggling through the water, these plates are brought together, so as to form a kind of conical lid to the end of the tube, thus preventing the water from entering. But when the larva needs air, it rises to the surface, pushes the end of the tube through it, and then splays the little plates outwards, so that they form a kind of miniature funnel (indicated in the figure), by means of which the larva hangs from the surface "skin." Air, but not water, now enters the tube, and in this way the larva breathes, much like a diver.

Now the strength of the surface "skin" differs with different liquids and, in addition, the strength of the skin of any liquid is altered by contamination. It so happens that the skin of kerosene oil is weaker than that of water and the skin of water is therefore weakened by being contaminated with kerosene. Hence, if kerosene be poured on a pond in which mosquito larva are living, the surface is no longer able to support their weight when they attempt to hang from it, and they can not take in air through the breathing tubes. The kerosene not only cuts off the normal supply of air, but also gets into the breathing tubes and chokes them, so that the larvae die.



The sag on the surface film makes a negative lens, causing a shadow

THIS method of killing the larvae has been successfully used to reduce very considerably the number of mosquitoes in those regions where, at one time, they were a pest, acting as carriers of the germs of malaria.

The surface film of water is only one example of the many existing phenomena of capillarity and surface tension in liquids. These form a fascinating chapter in the modern science of physics, from which a wealth of fact concerning the size and shape of molecules has been revealed, and there is a large though mainly technical literature on them.

Numerous examples of surface tension and other capillary phenomena exist. A familiar one is exhibited when we wash our hands with soap. Though soap is a chemical, based on stearic or some related acid, it has been learned within recent years that its main work is not done chemically but physically; the molecules crowd around and work beneath the dirt particles, actually shouldering them off by reason of the strong capillary forces they exhibit.

Soap bubbles, too, may be used in many interesting ways to display the laws regulating surface tension; some of these have been described, rather technically it is true, by A. S. C. Lawrence, former assistant to Sir James Dewar, in his recent book "Soap Films"; while the earlier researches of Dewar himself on soap films are widely known. The English physicist C. V. Boys also has written accounts of numerous related experiments. In short, the whole subject of surface tension and capillarity provides endless interest.

The normally small Des Peres River flowed behind the houses at the left. This photograph was taken during the flood of 1928. The great flood of 1915, however, reached nearly to the tops of the street lamp posts at this point

St. Louis Buries a River

By W. W. HORNER
Chief Engineer, Sewers and Paving

THERE is now being constructed in St. Louis a municipal drainage project on a somewhat larger scale than anything American cities have heretofore undertaken. The River Des Peres in St. Louis is, or was, a creek draining a basin of about 110 square miles. It flowed through St. Louis' best residence district, through the great Forest Park, through a heavily used industrial area, and, finally, across six miles of a developing semi-suburban district to discharge into the Mississippi River in Carondelet.

As the city has grown into this valley, sewers have been constructed discharging into the stream; as early as 1905 it had become an open sewer. Then, too, the great increase in the coverage of the permeable soil, which came about through paving and building, increased the runoff of storm waters so that the flooding of the lowlands occurred yearly with increasing severity.

The city discussed improved drainage along this stream for years but no administration was able to secure the necessary funds. Then in 1915, as an offshoot of a Gulf hurricane, a rain of over 10 inches occurred on this watershed in 20 hours. The resulting flood produced high-water marks many feet higher than any previous record; it isolated sections of the city, stopped operations on trunk-line railroads for as long as two days, and caused a serious loss of life. Thus the problem assumed alarming proportions.

Thereafter the carrying out of an improved drainage plan was a major issue in municipal affairs. Preliminary attempts to secure the funds failed but the matter was kept alive, and in 1923 a fund of 11,000,000 dollars was made available as part of the 87,000,000-dollar municipal improvement bond issue of that year.

IN the meantime sufficient funds had been available to permit surveys and detailed engineering studies to proceed, and in 1916 under the instructions of Hon. E. R. Kinsey, President of the Board of Public Service, a definite plan of improvement was worked out by the writer and adopted by the Board. This plan has been elaborated and revised, but is essentially the scheme on which the present construction is being carried out.

At the upper end of the project the river is taken into a 32-foot reinforced concrete sewer which extends for two miles to a point in Forest Park where it is enlarged to a double 29-foot concrete sewer and continues for another two miles. Below this point the drainage area is much larger and the cost of the complete "burying" or enclosing of the river would have been too great. A different plan was, therefore, adopted for the remaining nine miles to the Mississippi River, consisting of an open floodway for storm drainage and an underlying sanitary intercepting sewer.

At this time, three of the four miles of concrete sewer have been completed and the last is under contract. The central three miles of channel and sewer are complete and in service, while nearly all of the channel work for the lower six miles is under contract or has been partly completed. The whole project is scheduled for completion at the end of 1931. When finished, it will have substituted 13 miles of closed sewer and rectified channel for about 18 miles of the old natural tortuous river bed.

Two phases of this work must be of unusual interest to technically minded readers. The first of these involves the engineering studies underlying the design of the system and the more recent tests by which some of these are being checked, and the second the construction approach to the project which involved an unusual choice of tools and an

organization of the work to be carried out under recurring flood hazards.

The radical difference in the character of the plan, as between the upper and the lower valley, was due to a combination of surrounding circumstances. The plan for the upper valley involves the unusually large combined sewers, 32-foot and double 29-foot in size. The adoption of this type of plan was the result in part of the restricted conditions north of Forest Park, where residential and industrial development had encroached so closely on the creek banks that there was no room to maintain a flood channel of proper size unless arranged by the acquisition of very expensive lands. Then, too, the river could be completely inclosed in combined sewers at an expense within the limits that the people were willing to consider. Finally, the city had had to live so closely in conjunction with the unsanitary stream flow and continually recurring floods, that the popular irritation with the situation had passed ordinary limits, and no improvement would have been satisfactory which would not have removed these old sores completely from the surface.

IN the lower valley, each of these considerations was reversed. There was in most instances room to construct ample floodways on land that could be acquired at moderate cost, while the expense of complete enclosures of sufficient size to carry the great floods from the larger drainage basin would have involved costs many millions more than had ever been considered. Finally, this section of the city was not densely populated and, except in parts of the upper three miles, the flood damages and the nuisance factor had not injured a great number of people.

With the adopted plan definitely fixed, the first important factor and the most significant to the whole scheme was that which would fix the amount of flood water for which the works would be designed.

In sewer design, the question of rainfall and flood frequency has been extensively studied and engineers in different cities have adopted a variety of answers to the economic question. In general, city sewers are designed for such an amount of water that they are expected to be overcharged at frequencies of once in 15 years, under conservative policies, down to an average of once in one or two years where lower property values do not justify the greater expense.

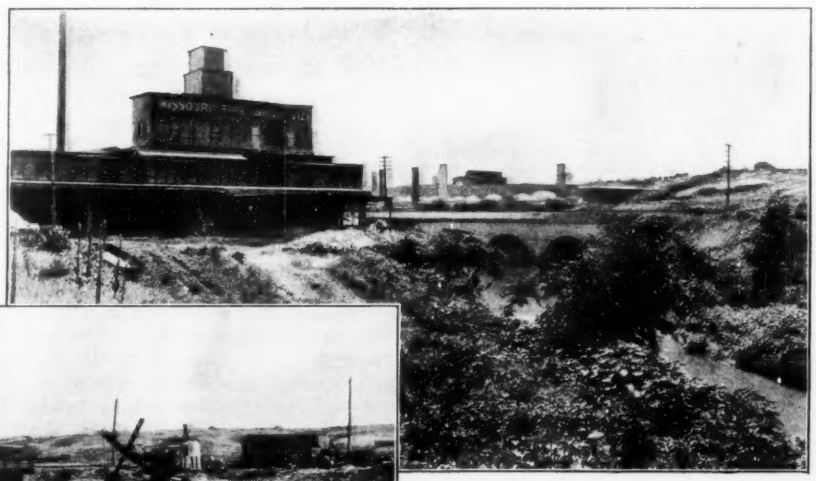
In the instance we have here, it was decided that the capacity of the River Des Peres works should be such as to care for any flood likely to occur once in 15 or 20 years, a slightly more ample basis than that used for smaller sewers. Obviously the determination of the volume of such a flood is not susceptible to exact analysis nor is there available any great amount of data of good character from which the answer can be worked out.

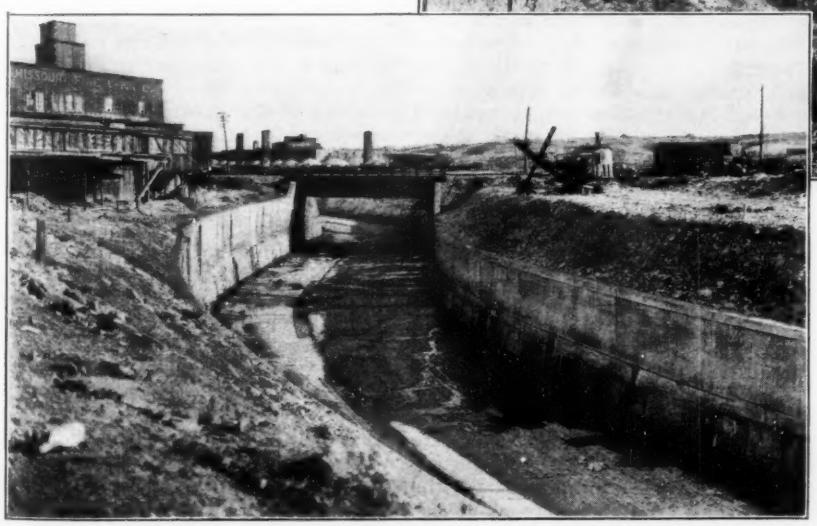
The figures of the amount of water per second for which provision must be made are very interesting, as showing what really terrific floods can come from small valleys with good slopes if the surface is not permeable. It is particularly surprising that the high-water flood of this little 110-square-mile valley may actually be greater than the low-water flow of the Mississippi River as it passes the city of St. Louis.

The size of sewers required on this project required us to use arches that are in a peculiar class. They are greater than the sewers originally involved in the city system and are smaller and of a different type from those ordinarily entering into concrete bridge design. Consequently there was little precedent for the engineering work to be done on them. It is not commonly known, outside the group of specialists who deal with this problem, that one of the dark spots in engineering knowledge is concerned with the pressures which earth places against such structures at the backs of retaining walls and the buried tops and sides of sewers and culverts.

ONLY in the last 20 years has any really scientific work been done in this field and most of this has been to determine the earth loads coming on small sewers either in narrow trenches or on culverts under highway fills. The result of this research work on small sewers was of some value in choosing the loads for which the Des Peres arches were to be designed, but the factors which the research had produced had to be exterpolated to such an extent as to be somewhat unsatisfying.

The arches are of reinforced concrete. The stresses were determined by an application of the elastic theory of arch design, the thicknesses were proportioned by an assumption that the compressive stress in the concrete



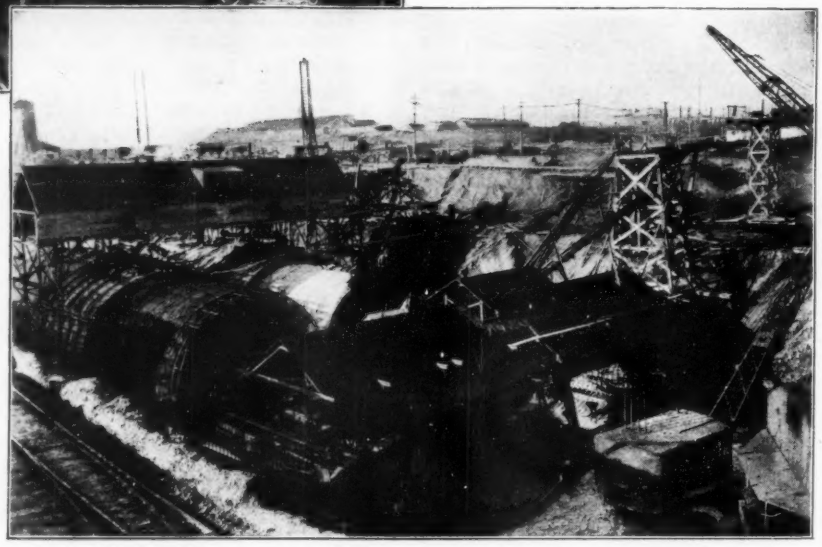


The change brought about by the improvement at a point east of Knox Avenue. The illustration above shows the undisturbed condition of the old river bed, and that at the left shows the completed work at the same point. It was necessary to demolish the concrete arch bridge of the Frisco Railroad and replace it with the steel structure shown at left

The single 32-foot sewer in process of construction in front of the Jefferson Memorial Building

would not exceed 800 pounds to the square inch and the tension from the steel bars would not exceed 22,000 pounds to the square inch.

It was critical to the progress of the work that the great steel centers on which the concrete was poured should be loosened and moved ahead for reuse as quickly as possible. It was decided that this support could be removed whenever the strength of the concrete reached 1200 pounds per square inch, and to determine this time, standard test cylinders were prepared out of the concrete as it was poured into the arch.



The double 29-foot sewer. In the right foreground is the 300-ton shovel with which the main excavation was done. Its arm has a reach of 90 feet

HAVING had to design these structures without as much satisfactory fundamental data as was desired, we felt it to be part of our duty to develop some of this data on this project for use in future structures. Accordingly a complete series of tests was developed in an effort to determine what the actual earth loads are and what the pressures under the footings are by building into the sewer a large number of Goldbeck pressure cells. These cells are interesting little machines in which the pressure of the earth against the face of a diaphragm is weighed by balancing this pressure with air pressure introduced behind the diaphragm. When the air pressure exceeds the earth pressure, a slight movement takes place, electrical contact is broken and the pressure may be read on an air gage.

Readings of earth pressures were begun as soon as the fresh backfill was placed over the sewer in September, 1928, and have been continued. It is very interesting to find that the actual measured pressures on the tops of the arches at the present time are equal to 50 percent more than the actual weight of the earth over these points would cause. One would be doubtful of the correctness of this result had not a similar condition developed on certain culvert tests made elsewhere. It appears that this is possibly because the settlement at the bottom of the deep fills on each side of the arches leaves the upper part of the fills relatively unsupported. A shearing stress is developed in the soil which transmits a part of the weight of the earth at one side of the arch on to the arch proper. This possibility was not realized at the time the arches were designed and it is fortunate that a large factor of safety has been provided.

The horizontal pressures are quite close to the assumptions used in the design, but we can see that these might not be true if the sewer had been constructed in the narrow trench instead of in a wide sloping cut.

The reactions under the footing are very peculiar. They seem to indicate that the inverted arch is supporting the center wall almost free of the ground, but we do not dare adopt this assumption, as some of the soil pressure cells occasionally fail to record when placed on shale or fireclay of hard quality as was the case here. This condition of reaction, however, is not impossible and leads to some interesting speculations.

The construction of the drainage works has been under way since 1924, when the first of the open channels was started. From the very beginning it involved unusual features not common in municipal sewerage.

As the new works lay in the valley and the site was closely restricted by both residential and industrial developments, a great part of the open channel and low level sanitary sewer had to be built in the creek bed or in such a way as to be continually crossing the creek. Construction operations were accordingly at the mercy of the weather and were subject to sudden interruptions by freshets which would sweep over the site and cover the equipment.

It soon became apparent that the success of the operation must lie in so over-equipping the job both as to capacity of the machines and as to the power used, that great progress could be made in the short periods between the rains. This led to the use of large draglines kept as far as possible out of the creek beds, assisted by small equipment in the stream to do the final trimming, this last equipment of a type that would not be seriously injured by continual immersion. In spite of the careful choice of equipment in this way, the work executed under such flood hazards was necesssarily very expensive and proceeded somewhat more slowly than was expected when the project was first started.

Whatever loss of time and unusual cost entered into the first three miles of

open channel was about balanced by the great savings which it was found could be introduced into the quantity production methods used on the construction of the big concrete sewers. These contracts, like the earlier ones, were equipped with extremely large and powerful excavating units. The high cost of having the work flooded was learned early in the progress and thereafter considerable expenditures to protect the site from floods yielded good returns.

Concrete for most of the work has been manufactured in central station plants of large capacity, completely equipped with machine handling devices and automatic controls of materials and of water. It was hauled to the site of the work in one case by industrial trains and in another in dump trucks. These central concrete plants not only proved to be very effective in lessening the cost of the product but were extremely valuable in producing uniformly well-proportioned mixtures. This last result was brought about not only through the efficiency of the mechanical control apparatus but also through the necessity of securing the result, as the concrete not so accurately proportioned was not subject to long haul without segregation.

The value of these quantity production methods and of protecting the work from interruption by floods is shown by the progress records actually attained. In the month of September, 1929, each of the contractors produced 30 units of sewer on 30 consecutive days. As these units were either 30 or 35 feet in length, nearly 1000 feet of sewer were built on contract that month.

Where the last contract of the big 32-foot sewer is just now being started, most of the construction must take place in a narrow gorge through which the river runs, as there is very little working room on either side. The contractor here, Stiers Brothers, has developed a totally different type of equipment consisting of duplicate electrically-driven tramways of about 1800-foot spans to haul the material in and out, and small shovels and draglines in the river bed loading skips.

ONE of the things that every worker in the ground has come to fear is the encountering of wet running soils, sometimes called muck, sometimes quicksand, depending on the amount of clay present. It has almost gotten to be a tradition among sewer contractors that when quicksand is encountered, all ordinary plans must be abandoned and enormous costs are involved in holding back the running earth with sheet piling, timber, and other effective barriers.

In recent years engineers and the more understanding operators have learned that this material is essentially the same as any other soil except for the presence of an excessive amount of water, sometimes under pressure. Systems have been devised for removing this water through pipes driven into the ground and, where the sands are sufficiently coarse, stable soils are produced.

A very interesting problem of this general kind entered into the building of the Des Peres works. This problem arose because the new improvements were to give the same standards of drainage as did the city sewer system and accordingly these works must carry the floods at levels of eight feet or more below the improved ground surface. With the flood water levels so fixed, the bottoms of the channels or sewers were at a great depth below the old creek bed, sometimes as much as 25 feet.

When work on these deep excavations was started in the middle of the natural valleys, the first operation was to open a hole or excavation to the new depth. The natural result of this was that all the soil moisture in the surrounding area tended to flow to the low level outlet. In passing through the soil adjacent to the trench, the pores of the soil were filled under pressure, instability resulted and there was a continual tendency for the banks of the excavation to slide or slough in.

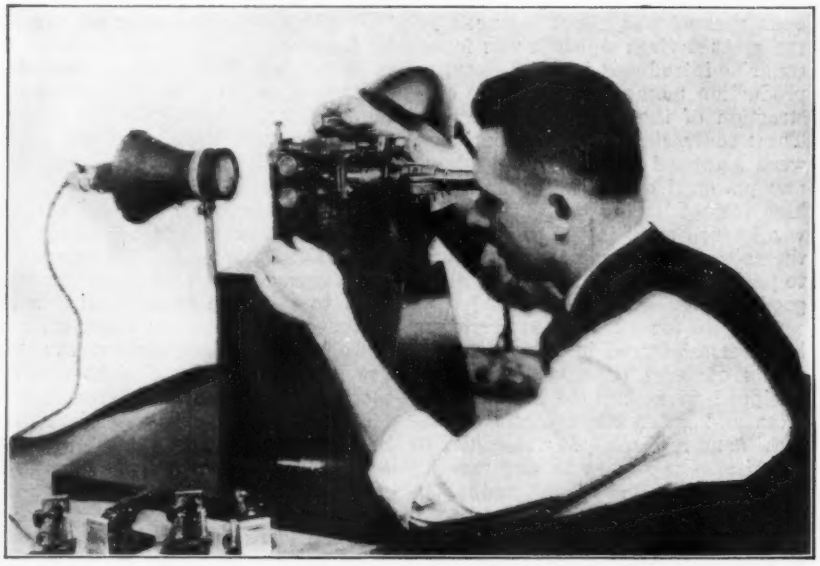
At the beginning of the work, this condition horrified the operators and they were quite sure for a time that the low level structure could never be built, or, if built, that the banks would be continually sliding and that the concrete or rip rap paving laid on the banks would be crumpled up and demolished. They advised, instead, that heavy reinforced linings be placed capable of holding back the terrific soil pressure. A small amount of such lining was actually placed as an example only, for we were convinced that the soil would become stable once the excess moisture had drained out and the pressure of the water in the pores was relieved. Accordingly, we arranged for the rough excavation to proceed and for the trimming of the banks and the placing of the lining to be deferred. A slow outseeping of moisture followed, the ground water level in the valley was gradually lowered and within six months after the original excavation the banks had become re-stabilized throughout. Of the first 30,000 feet of channel bank so treated only 300 feet gave trouble after completion and that was at a point where the bank had been supercharged with a fill of wet clay.

So effective was this means of securing stable soil by natural seepage that when one section had to be started without an outlet, it was decided to simulate this condition artificially. Six months before the beginning of the work a pumping well was sunk to the level of the proposed excavation, drain tiles were run out along the site of the work for several hundred feet and the ground water was continually pumped until the time the work began. When the big machines actually arrived and the new cut was opened the soil was found to be quite stable and no difficulty whatever arose. It was further found that once a stable condition of this sort was created, the soil moisture would drain effectively to the excavation at about the rate at which the work was able to progress up the valley so that difficulties of this kind only occurred where a new depression was opened.

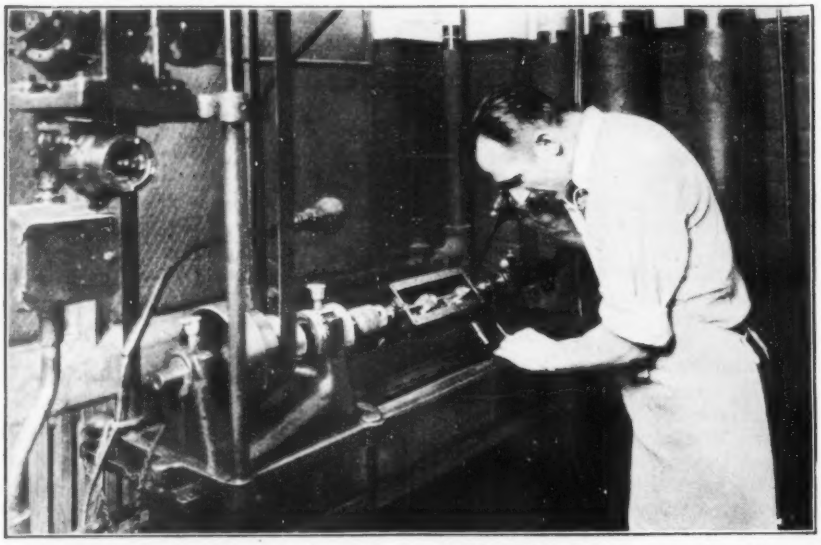
SEWER construction has for a long time been in the hands of practical men who have been accustomed to fight their way out of difficulties and it is very interesting to find how often an adaptation of some relatively simple law of science can make easy the progress of work of this kind.

A section of the job showing one of the heavier floods passing over the construction work. The crests of these floods usually were of a few hours' duration

Checking parallelism of film sprocket faces. Microscopic measurements are made of all of the parts



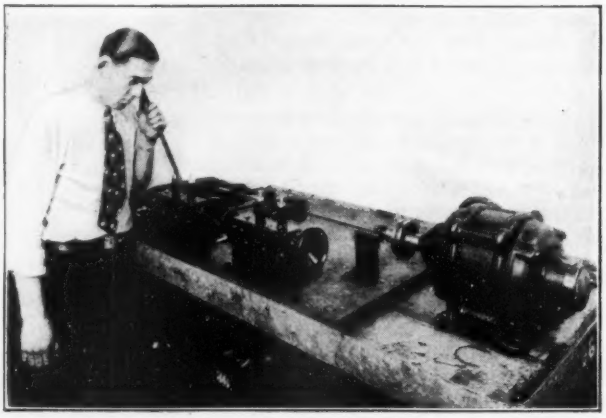
An optical system being adjusted. A highly accurate beam of light is required for film reproduction



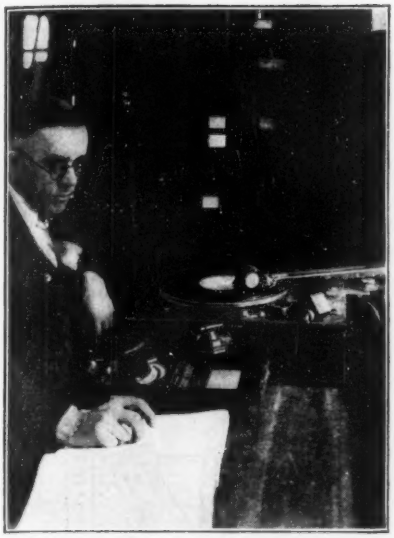
The main drive on the base of a universal projector consists of three sets of bevel gears with the drive gears on a single shaft. These all must be quiet when in operation

Right: The gears in a motion-picture projector must run without back-lash. After the machine has been run, the gears are checked for back-lash and bearing clearance

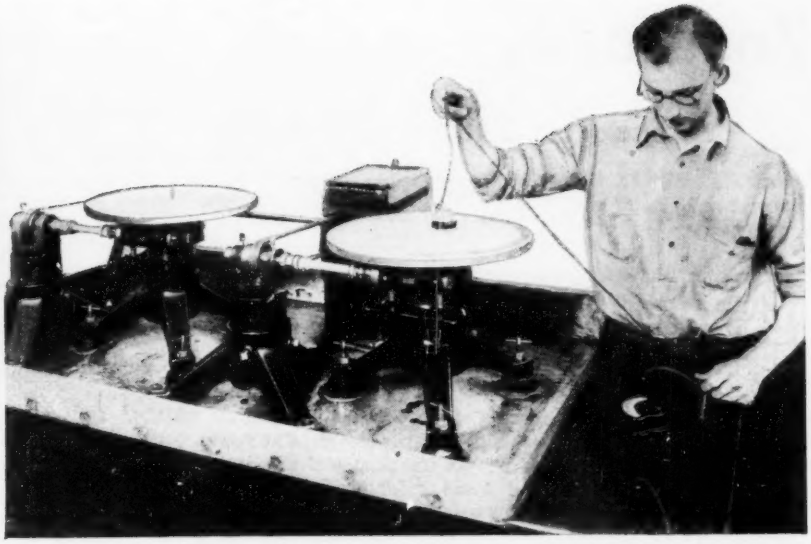
The adjustable film aperture must be accurately made so that its image on the screen, enlarged over 200 times, will show no defects. *Above:* Checking aperture



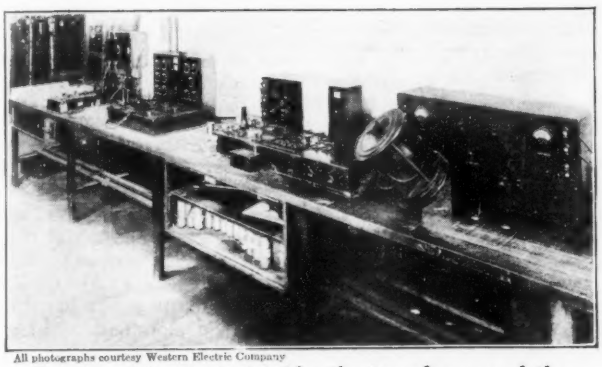
A main drive unit has been assembled and run in. Before it is shipped to the theater, it must be tested once more. The operator is listening for tell-tale noises



The electro-magnetic reproducer for disks is tested for operation

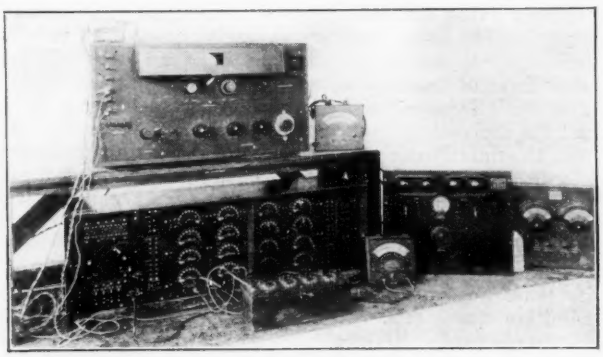


An "electric ear" is placed on the record turn-table as it whirls around on the test bench. A sensitive meter tells the operator of any noise-making faults



All photographs courtesy Western Electric Company

On this elaborate test table, the transformers of the amplifiers are tested for their electrical characteristics



The assembled amplifiers are subjected to tests more rigorous than actual operating conditions in theaters

Accuracy In 'Talkie' Equipment

ACCEPTANCE of talking motion pictures as a permanent part of the entertainment field has imposed on the manufacturers of motion-picture projectors a standard for their mechanical work that rivals that set by the makers of the finest watches. Not only must the machine project perfect motion pictures, but it must also be the source of accurately synchronized sound and voice effects.

It is doubtful if there is any other delicate machine of which more is required than a motion-picture reproducer. It must be rugged enough in construction to stand the rough usage and steady grind of every-day operation, yet parts of it must be so delicately constructed that they can handle without distortion minute voice currents so small that only the most sensitive meters will measure them. A universal type of machine can transform almost microscopic marks on the film into the most delicate shadings of sound or it can be run with disk records to reproduce from tiny scratches in the grooves on the disk. At the same time, the projection mechanism must be functioning, passing the film before the aperture where it is brought to a dead standstill 24 times a second. Yet, about 14½ inches from the point where the film is started and stopped, it must be flowing smoothly past the sound-light aperture without the slightest pause or jerk.

IT is small wonder, then, that the manufacture of sound-picture projectors requires a huge staff of inspectors. The machines must be so perfect when they leave the factory that, when they are installed in a theater, they will operate properly from the first turn of the switch. There can be no breaking-in period in the theater, such as the automobile owner gives his car, for the first performance of a projector is usually judged more critically than any other. Therefore the machines are carefully tested before they leave the shop, and the gear drives are run-in, under load, for periods varying up to 24 hours. This operation removes any burrs and irregularities from the gears, and insures that the final tests for noise and irregular operation will show whether all of the parts are meeting the exacting requirements of theater conditions.

In the photographs on this and the opposite pages we show some of the many intricate tests and inspections that are made before the projector is finally considered up to standard and is shipped to the theater. Here also it is constantly tested in preparation for each daily grind, to insure that the performance will go through without mechanical or electrical failure.

Zoogenesis

The New Theory of Evolution

By AUSTIN H. CLARK
United States National Museum

FROM the very earliest times the absorbing mystery presented by the multitudes of different forms of animal life has attracted the attention of the studious among all human races.

We know that all living things are derived from other living things—life can not arise spontaneously. So in the extremely remote past all forms of life must have had a common origin. No one with any knowledge of biology doubts this, and those with no knowledge of biology are in no position to deny it.

Every living thing is evolved from a particle of living matter—a single germ cell—in which no trace of the adult form of that living thing is discernible. This cell divides into two and the derivatives continue to divide until the final form—cow, insect, crab, jelly-fish or something else—eventually is attained.

Since every animal, no matter what it is, originates as a single cell, we are safe in saying that all types of animal life must be explained in terms of a primitive single cell.

THE course of the development of animals from a single cell to multitudes of different kinds we know today is explained by what is commonly known as the theory of evolution.

Evolution assumes the gradual development step by step of all the widely varying forms of animal life from an original form of simple structure.

Galago, similar to the supposed common ancestor of man and the monkeys

But the developmental course which has been followed by animal life from its first beginnings down to the present time can not be reduced to any such simple formula. There are three separate sets of facts to be considered, and any acceptable theory of animal development must harmonize and correlate all three.

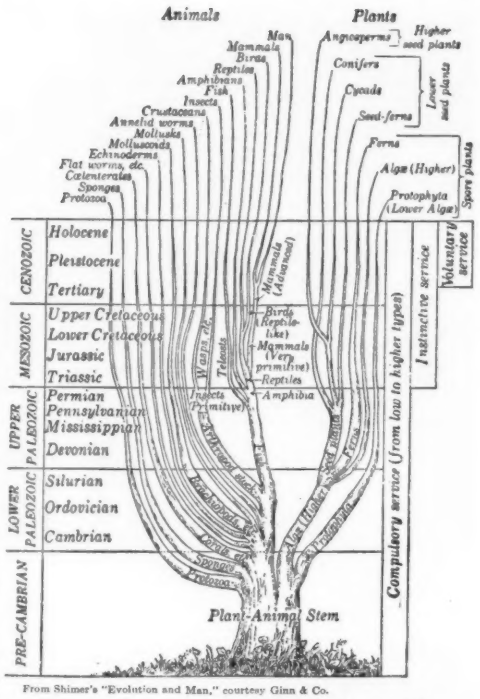
In the first place, within each of the so-called phyla or major groups of animals, as is well seen in the vertebrates, particularly in the mammals and the reptiles, there are many well marked, obvious, and undeniable evolutionary lines or "trees" which, beginning with a relatively simple form of creature, run by easy stages to a specialized and highly complex form.

In the second place, very few of these evolutionary lines are perfectly continuous. Practically all of them are more or less frequently interrupted by gaps of various widths, and these gaps are often very broad. Especially is it true that these evolutionary lines tend to be separated from each other throughout their entire course, running parallel clear through to their earliest beginnings and not converging to a common type of animal as we would expect. For instance the cat line and the dog line are always separate. No forms intermediate between cats and dogs are known, although both cats and dogs are collateral members of the great group of carnivorous mammals called the Carnivora and must have had a common ancestor.

SIMILARLY there are no intermediates between turtles and snakes, both types belonging to the reptiles, or between squid and oysters, though both types are mollusks.

In the third place, no animals are known even from the very earliest rocks which can not at once be assigned to the proper phylum or major group on the basis of the definition of that group as drawn up from a study of living animals alone. A backboned animal is always unmistakably a backboned animal, a starfish is always a starfish, a mollusk is always a mollusk, and an insect is always an insect, no matter whether we find it as a fossil in the rocks or catch it alive at the present day.

There can be only one interpretation of this entire lack of any intermediates between the major groups of animals, as for example between the backboned animals, the starfishes, the mollusks, and the insects. If we are willing to accept the facts at their face value, which would seem to be the only thing to do, we must believe that there never were such intermediates; in other words that these major groups from the very first all bore quite the same general relationship to each other that they do at the present time.



From Shimer's "Evolution and Man," courtesy Ginn & Co.

Tree of the evolution of living forms. The lower (pre-Cambrian) part is an assumption, like some of the unbroken branches

Is this creationism? Not at all. It simply means that from the single cell life, at its very first beginnings, developed simultaneously and at once in every possible direction. All of the phyla or major groups seem to be of simultaneous development. From each one of them a separate evolutionary tree arose, growing upward through the ages.

The numerous developmental lines are explained by the process of evolution as that term is commonly understood. This descriptive word should be restricted to these developmental lines.

THE gaps within these lines, and between related lines which run more or less parallel, are explained by the theory of mutation.

The complete absence of any intermediate forms between the major groups of animals, which is one of the most striking and most significant phenomena brought out by the study of zoology, has hitherto been overlooked, or at least ignored. This condition may readily be explained, from an application of the facts gained from a study of embryology, by a theory which may be called the "theory of eogenesis."

Restriction or expansion of the meaning of a well-known word results always in confusion. The term evolution has been used to cover the entire developmental history of animals. But the theory of evolution is based upon, or at least was drawn up from, only a portion of the facts to be explained. It

was formulated from data taken from only a partial survey of the field. A better understanding of the whole subject of the development of animals will result if we call it "zoogenesis" and consider zoogenesis to embrace three interrelated phases, (1) evolution, (2) mutation, and (3) eogenesis.

WITH regard to evolution, the first of these three phases: To illustrate evolution as here restricted let us briefly review the history of the mammals and the reptiles, bearing in mind that similar histories are found in many other less familiar forms of life.

The reptiles first appeared in that very ancient time which is known to geologists as the Carboniferous, and gradually increased in diversity and in maximum size. The largest land animals of which we have any knowledge are the largest of the dinosaurs, which flourished in those periods known as the Jurassic and Cretaceous.

At the end of the Cretaceous period most of the larger and more spectacular of the reptiles suddenly disappeared, but many reptilian types, as turtles, lizards, snakes and crocodilians, continued right through to the present day.

The mammals first appeared in the form of very small and insignificant creatures at the time when the great reptiles were the dominating giants of the land and sea. After the sudden disappearance of the giant reptiles the mammals increased greatly in diversity and somewhat in size, though in the earlier portion of the following epoch the largest mammal was not so large even as a sheep.

These mammals of the earlier portion of the "dawn period" (Eocene) soon disappeared; but as they disappeared their place was taken by other types which were more or less comparable to the sorts we know today. Gradually as time went on these mammals became more and more diversified. Various extraordinary types, some of huge size, appeared and not long afterwards disappeared, while together with these came others which we have no difficulty in recognizing as the direct predecessors of the types we know at the present day.

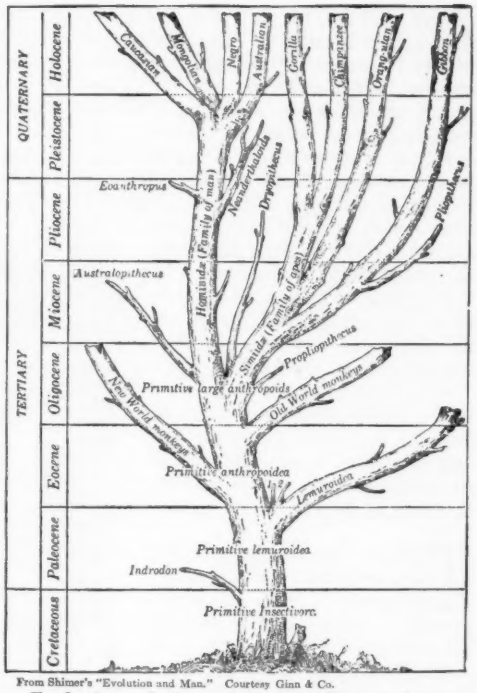
In order to make the picture clearer, let us narrow our perspective and focus our attention on the horses. In the "dawn age" we find a curious little creature no bigger than a fox called the "dawn horse"—*Eohippus*. This had four toes on the front and three on the hind feet, and a relatively short head with the eyes about half way between the ears and the tip of the nose, instead of nearer the ears as in the later horses.

Following the "dawn horse" we find a number of different kinds of horses, mostly about the size of a shepherd dog or a little larger, all of which had three toes. Like the "dawn horse" and its relatives they had low-crowned teeth which were affixed to the jaw by means of roots.

Still later there were horses which as colts had low-crowned teeth but when fully grown had teeth with fairly high crowns. With these lived others in which the teeth had high crowns at all ages. These horses had shorter muzzles and rather less deep jaws than the modern horse and, while they had a single rounded hoof, there was a toe on either side of it. These lateral toes varied from small ones which did not reach the ground to larger ones which reached the ground. Though these were larger than their predecessors, they were not so large as the later horses of the modern type.

In the Ice Age we had in North America many different kinds of horses which were all of the modern type with long high-crowned teeth and deep jaws. They ranged in size from little ones no bigger than the smallest Shetland pony to some which were larger than the largest draft horse.

Before the discovery of America by the Europeans all of these disappeared, for what reason we do not know at the present time.



From Shimer's "Evolution and Man." Courtesy Ginn & Co.

Evolution of the primates. The author accepts man's ultimate relationship with the apes but points out that there is no intermediate type, either living or extinct

THIS brings us to mutation, the second of the three interrelated phases of zoogenesis mentioned above. In many other animal types we are able to trace, as in the horses, a gradual evolution from a form simple and generalized in structure to one or many forms which are highly specialized. But this is by no means always so. Indeed, it is the exception rather than the rule.

Stegosaurus, extinct reptile of the Cretaceous period, United States National Museum in Washington. When this stupid big brute was lumbering around in Wyoming in the Cretaceous period the ancestor of all the modern mammals was no larger than a rat

Most lines are broken by curious gaps which may be small and insignificant, or broad and striking. It is commonly assumed that these various gaps are due to our lack of knowledge of the animals concerned, and especially of their fossil record. No doubt in very many cases this is true, but in most cases these gaps probably are real and were never bridged by "missing links."

In the light of our present knowledge we can not doubt that all living things are the children of other living things, and that life has been continuous from parent to child from its earliest beginnings. How is it possible to harmonize this fact with the occurrence of broad and unbridged gaps in the evolutionary lines?

THE answer is, that continuity of life does not necessarily imply continuity of the bodily form in which that life is manifested. In other words, children may be very different from their parents. As an illustration of continuity of life coupled with abrupt and striking discontinuity in form, and also in mental traits, let us consider the dogs.

According to the best authorities all of the nearly 200 different breeds of domesticated dogs are descended from a single type of ancestor, which is a wolf closely resembling our native wolf. The domestic dogs may be grouped, following Gibson, into wolf-dogs, greyhounds, spaniels, hounds, mastiffs and terriers.

Some of the wolf-dogs, like the dogs

of the Esquimaux and the Kamchadales, show a more or less close resemblance to wolves, while others, like the collies, Newfoundlands and St. Bernards, are much less wolf-like. But the wolf-dogs may be arranged in a fairly continuous series from the most to the least wolf-like. This series of dog forms is parallel to many of the evolutionary lines which are seen in the geological history of the mammals, as for example, in the horses. It is a series of types passing by almost imperceptible gradations from one extreme to another which is very different.

Of the other types of dogs we may select the greyhounds, hounds, bull-dogs and pugs, the last two from the mastiff stock, as representative types known to every one.

THE greyhounds or, as they are sometimes called, the "gaze-hounds" have deficient powers of scent, but unusually keen eyes. They hunt entirely by sight. There are many different forms of greyhounds. The hounds, having poor sight, hunt by scent, and are also divided into many different forms. Bull-dogs are deficient both in sight and scent, and are stupid and ferocious, displaying but little affection. Pugs, which are much like bull-dogs and are equally stupid, differ markedly from them in being timid and affectionate.

There are no intergrading types between the greyhounds, the hounds, the bull-dogs and the pugs, and there are no intergrades between any of these and wolves. If we did not know their ancestry we would never suspect that these types of dogs had anything to do with each other, or with wolves. They illustrate unbroken continuity of descent coupled with wide and abrupt changes in form and in mental attributes.

An understanding and appreciation of the conditions found among the dogs enables us to approach the problem of the relation of man to the animal world.

Structurally and anatomically man is very close to the man-like or anthropoid apes. This is a readily demonstrable fact which is quite beyond dispute. But it is also beyond dispute that there is a sharp, clean cut, and very marked difference between man and the apes. Every bone in the body of a man is at once distinguishable from the corresponding bone in the body of any of the apes.

Furthermore, man differs very widely from the apes in the possession of articulate speech which enables him to accumulate knowledge in successive generations. He also differs in his use of fire and in his use of tools which, as is shown by the fossil record, have been human attributes from the very first. Besides this, so far as history and the study of modern races enables us to judge, he differs in his use of clothing and of ornaments.

The most important difference, however, is correlated with the fact that in man the ministrations of both parents are necessary in raising a family. A woman can not raise a family unaided. Interdependent with this we find in man a socially effective sentiment of love which creates and makes a unit of the family. The existence in all human races of taboos and laws directed toward the maintenance of the family would seem conclusively to show that family life was from the first a fundamental human institution. For laws and taboos are not, so far as we know, invented to mold society into a new and preconceived form, but on the contrary to correct the evils recognized as possessing disruptive or destructive tendencies which from time to time appear.

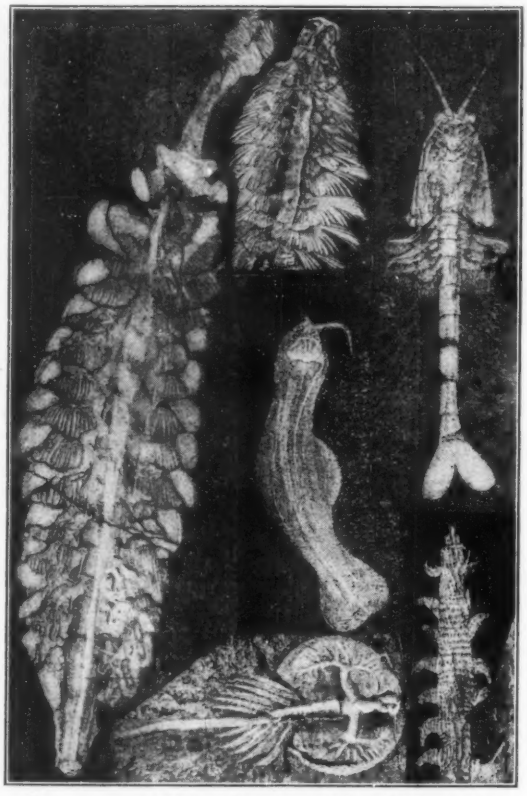
All monkeys, so far as we know, live together in promiscuous hordes or troupes in which each female raises her own young unaided. Family attachments are not necessary and do not occur.

While man obviously belongs to the same division of the mammals as the apes, yet the differences between man and the apes seem to be too great ever to have been bridged by intermediate types, and of all the fossils that have been found not a single one represents indubitably a "missing link."

Man appeared suddenly as a collateral line from the same general complex as the apes, but he was never one of them. Between man and the apes there is a gap, structural and psychological, of the same general nature as that between the greyhounds, hounds, bull-dogs and pugs. But while we know that the domesticated dogs are all descended from a wolf, a creature differing from all of them, and very widely from most types, we have no definite clue to the immediate ancestor of man.

The general features of human structure and anatomy were inherited, in accordance with the unbroken continuity of descent from parent to child, from some unknown ancestor common to all the primates but so far as we have been able to discover, not through an ape. The details of his structure and his mentality are his alone.

Continuity of descent coupled with abrupt discontinuities or changes in form is a common, striking, and well known phenomenon in most types of animal life. We must accord it a proper place in any theory dealing with zoogenesis.



Some remarkably well preserved fossils from the Cambrian period of British Columbia, nearly a billion years ago, almost our oldest fossils, yet doubtless not half as old as life. Even in the Cambrian, the author states, the major phyla were as distinct as today, with no intermediate forms

FINALLY, with regard to eogenesis, the third phase: As we look over a series of fossils from the very earliest rocks, those of the Cambrian, we notice sponges, mollusks, crustaceans, echinoderms, and various other types of invertebrate life. Among the divisions of these groups we recognize pteropods and gastropods, crinoids, sea-cucumbers or holothurians, gephyreans, polynoids, and many other sorts.

How is it that we are able to recognize these so promptly? The reason is that these earliest animals all fall within the several phyla or major groups as these phyla are defined on the basis of the living types alone. We do not have to expand our definitions of the phyla to include all the fossil forms of whatever age.

The very earliest vertebrates, crustaceans, insects, or mollusks were just as unmistakably vertebrates, crustaceans, insects, or mollusks as are the representatives of those groups which we find living at the present day.

What is the significance of this? It

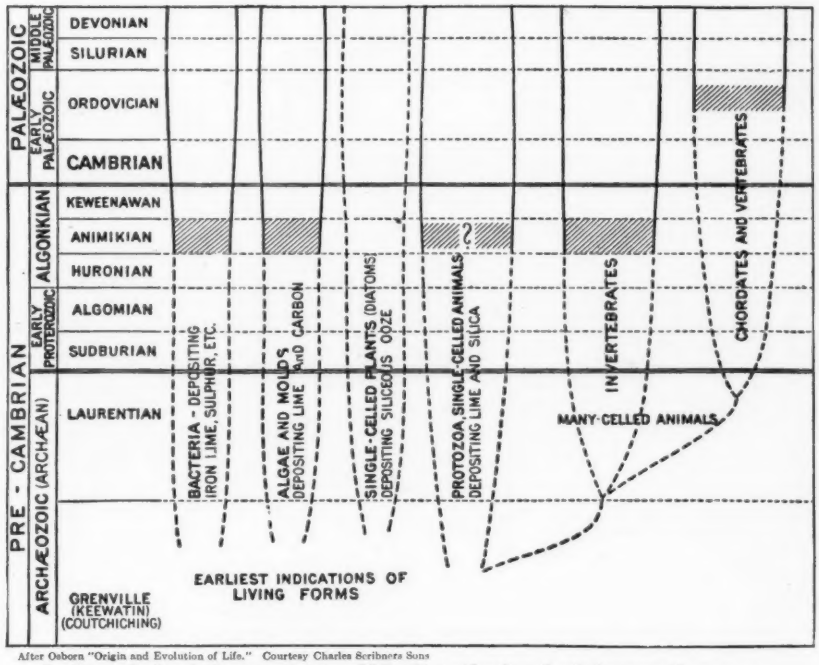
can have only one meaning, and that is, that so far back as Cambrian times, at least, the major groups of animals bore the same relationships to each other that they do today.

This is an established fact concerning which there can be no doubt whatever. In spite of the numerous and profound changes that have taken place in the various sorts of animals included *within* each phylum, the interrelationships *between* the phyla themselves have undergone no change at all. No intergrading forms occur between any two of the major groups, and so far as we know no intergrading forms ever have occurred.

WHILE the fossils in the Cambrian rocks are the very earliest fossils that are adequately known, yet it is undoubtedly true that the Cambrian is much nearer to the present epoch than it was to the far distant time when life on earth began, so that conditions in the Cambrian are not necessarily those which obtained at the time of the origin of life.

The answer to this objection is that since we know that the interrelationships between the phyla or major groups run back without the slightest change to the Cambrian, it is more relogical to assume a continuation of these interrelationships into the indefinite past than it is to assume, somewhere in the unknown pre-Cambrian ages, a change in the interrelationships, for which last assumption there is not the slightest evidence.

Since there is nothing to be learned bearing on the interrelationships of the phyla from a study of the fossils, in order to solve the problem we must rely on the data supplied by the study of the special science of embryology.



After Osborn "Origin and Evolution of Life." Courtesy Charles Scribners Sons

Earliest phyla of plant and animal life. Note the five shaded areas; these represent the geologic date of the earliest known fossil forms. The duration represented by the part of the chart below (earlier than) this date is about one billion years and the dotted line relationships are filled in wholly by inference

The details of the process by which all of the phyla or major groups presumably arose simultaneously, or practically so, from a primitive single cell are very complicated and too technical for repetition here. They are given at length in a paper entitled "The Origin of the Vertebrates" (*Journal of the Washington Academy of Science*, Volume 13, No. 7, April 4, 1923, pages 129–138) to which the interested reader is referred for these details.

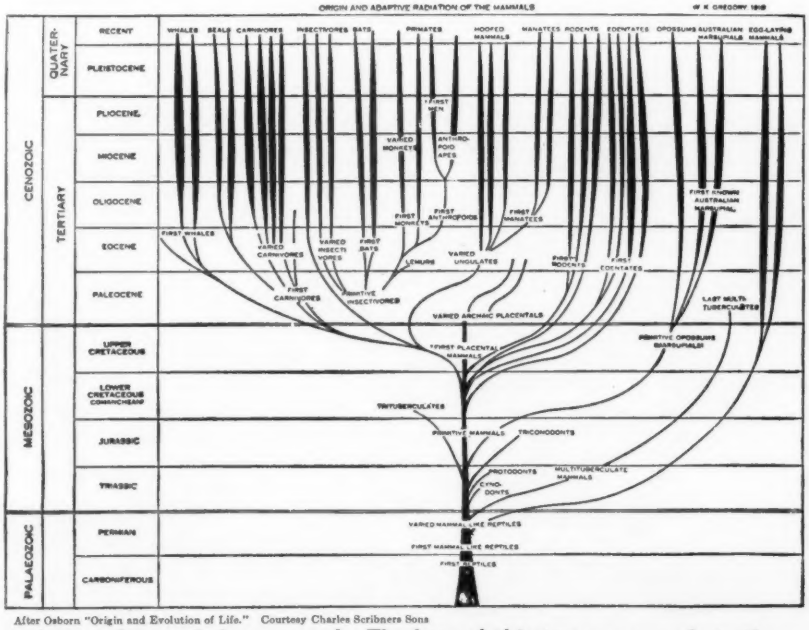
Thus, by a process which has been designated as eogenesis, all of the phyla or major groups of animals appeared simultaneously or nearly so. Although this sudden and simultaneous origin gives them the appearance of having arisen through special creation, *the origin of each may be traced back to the primitive single cell.* However, there is no evidence that single celled animals—the protozoans—are more primitive than other types, or preceded them.

By this process of eogenesis the phyla or major groups came into being, and each of these stands at the base of a separate and distinct evolutionary tree which rises upward through the ages.

THE branches, branchlets and twigs of these evolutionary trees are indicated by interrupted lines, the interruptions or gaps representing mutations whereby discontinuities in form and structure occurred between parent and child.

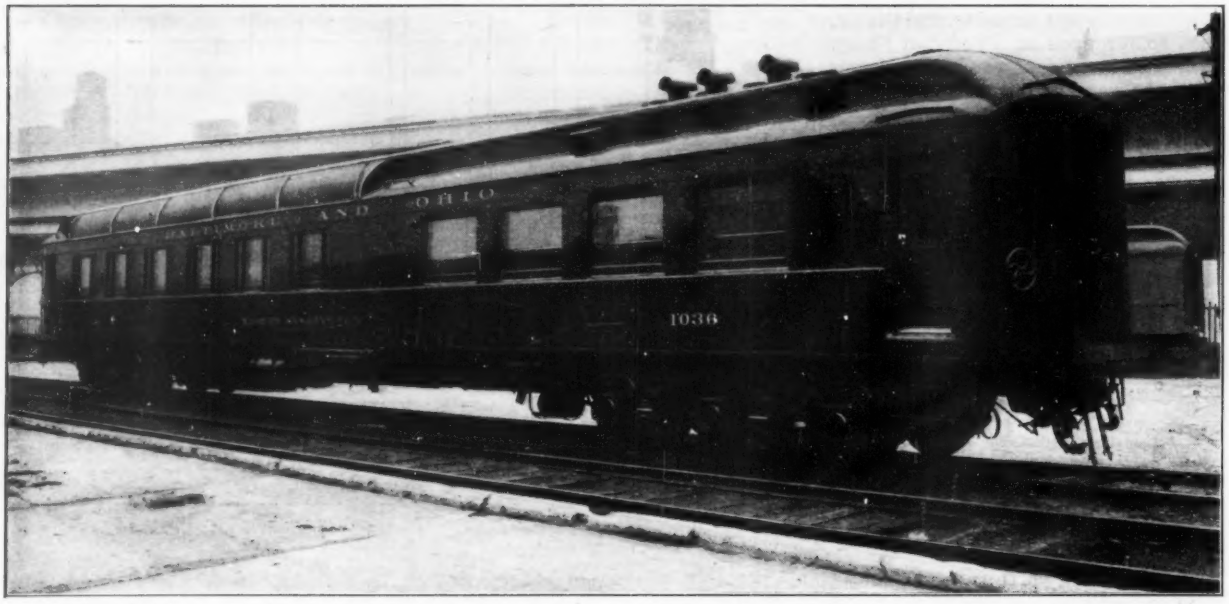
This is the picture of the development of animal life—of zoogenesis—which is to be drawn from the facts as we know them, and it is the only possible picture which is in accordance with those facts.

This new concept of evolution differs from the old chiefly in the assumption that the basic type in each of the major groups (phyla) arose through following a special developmental path from the primitive cell, the divergence for the most part beginning in the so-called gastrula, a developmental stage common to all animals except the sponges and the protozoans.



After Osborn "Origin and Evolution of Life." Courtesy Charles Scribners Sons

Ancestral tree of the mammals. The base of this tree corresponds to the branch labeled Reptiles, at the center of the complete tree on page 104



Exterior of dining car. Much of the air-cooling and air-conditioning apparatus is concealed underneath the car.

The curved hood along the top of the car at the farther end contains the air passages connecting with the louvres

Dining in a Refrigerator!

SUMMER rail travel is rendered uncomfortable by heat, dust, cinders, smoke, and noise. Engineers have been working for many years to mitigate these evils but the problem has been a most difficult one, for the air must be freed from all foreign matter before it can be dehumidified and cooled. A refrigerated car would be a great boon in traversing the great deserts of the southwest. Natural ice has been tried, but the expense was too great.

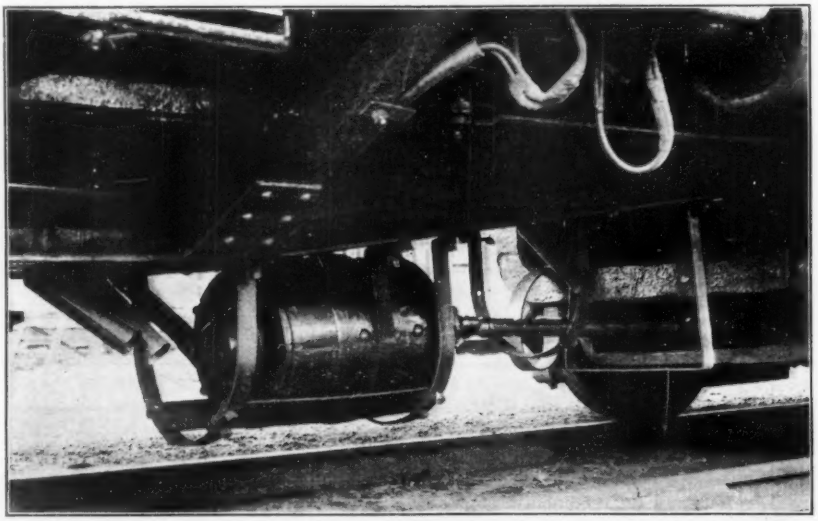
Now, however, the riddle apparently has been solved. The design and installation of the special equipment required was co-operatively worked up by the Baltimore and Ohio and the Carrier Engineering Corporation and the complete installation was made at the Mount Clare shops at Baltimore.

A run was made, with the full winter heating capacity of the car turned on. This was intensified by the heat of the kitchen and the warm weather outside. When the temperature reached 93 degrees, Fahrenheit, the new system was put in operation and in 20 minutes the temperature had dropped to 70 degrees, or more than a degree a minute. It was also shown that the temperature could be lowered considerably further but this would not often be necessary or desirable.

THE automatic control of the air-conditioning and cooling apparatus can be set by the steward or whoever is in charge of the car. The cooling equipment as well as the running gear of the car is so insulated with rubber cushions that vibration and noise are very largely eliminated. The car is also equipped with roller bearings.

The cycle of operations will be understood by reference to the schematic diagram. The car is equipped with double sash windows which are kept closed at all times and the doors are opened and closed only to allow for the entrance and exit of the passengers and the train crew. The outside air is admitted through air filters located at the roof line. All the dust and cinders are removed from the air by mechanical filtration. The air is then cooled to the proper temperatures by passing over cooling coils. It is then carried throughout the car by overhead insulated ducts. There are no drafts created and the cool dehumidified air is distributed through louvres.

The equipment is electrically operated and as the requirements are in excess of the ordinary axle generator for lighting purposes, a special 10-kilowatt generator has been provided to supply direct current of 110 volts. The water used in the condenser is delivered by a motor-driven pump to a "cooling tower" or "spray unit" at the end opposite the kitchen where fresh air drawn from the outside is passed



The 10-K.W., 110-volt direct current gear-driven generator supplies the electrical energy for the operation of the air conditioning and cooling plant

through the water spray, and thus the temperature of the condensing cooling water is brought back to approximately that of the outside air after which the water is available for re-circulation. The water which is lost by evaporation is taken from an overhead supply tank.

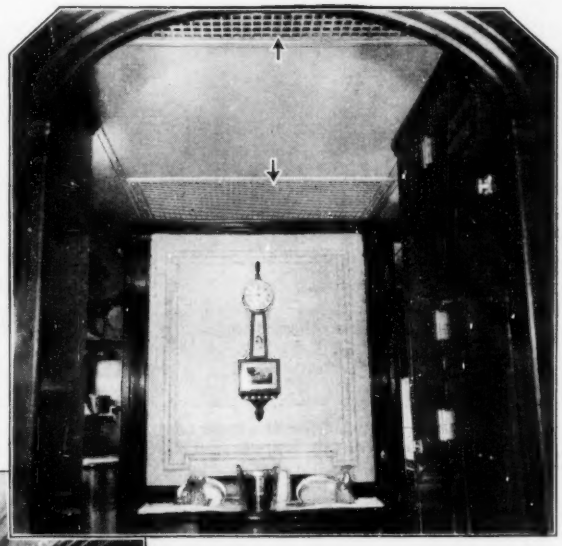
The temperature of the conditioned air which is delivered through the overhead louvres is dependent upon the chilled water in the cooling coils located overhead at the pantry end. This in turn is automatically regulated to suit the conditions by a temperature control device which through an arrangement of movable louvres so directs the re-circulated air as to prevent too low a temperature in the car. This is under the control of the steward of the car so that a comfortable temperature will be maintained at all times. If the temperature of the cooling water becomes too low, freezing of water in the evaporator may occur. To prevent this the back-pressure valve in the ammonia system will automatically cut off the supply of ammonia, thus preventing a further lowering of the temperature. The relative humidity can be controlled within certain limits depending on outside atmospheric conditions and the temperature maintained within the car.

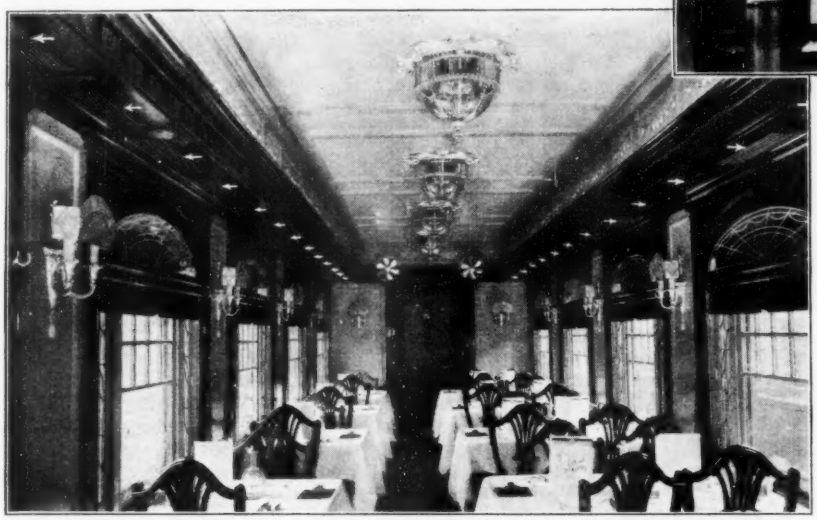
At terminals and layover points, the equipment will be in operation sufficiently long in advance so that the car will have a comfortable temperature before being attached to a train. The system automatically begins operation when the train attains a normal speed under ordinary conditions. The time when the equipment is not functioning because of low speed, or while standing at stations, is so small that the loss would be negligible, and comfortable conditions can be maintained at all times.

Early in July, 1929, tests were carried out by the Baltimore and Ohio Railroad and the Carrier Engineering Corporation with a coach. It is believed that this was the first railway passenger car ever so equipped for air conditioning and cooling. The equipment was applied about the first of July and the tests made during the hot summer months indicated that comfortable conditions can be maintained within cars whether fully or partially occupied by passengers under the worst conditions of temperature and humidity which are likely to prevail. The *Martha Washington* was the next step forward.

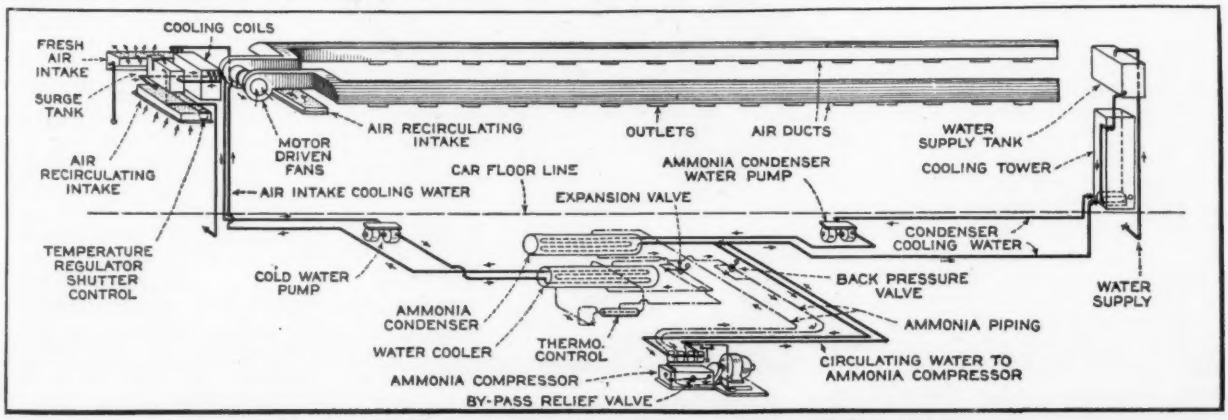
The tests of the *Martha Washington* were made by Col. Geo. H. Emerson, chief of motive power and equipment, J. H. Davis, chief of electric traction of the Baltimore and Ohio Railroad, and officials of the engineering company. This was the first car in service on any railroad to be so equipped.

The next problem which should be attacked is the air conditioned and refrigerated sleeping car. This is a much greater engineering problem than the dining car for the reason that the cubical space to be treated is much larger, as quite a bit of the diner is taken up with kitchen, pantry, and passageways. There is an abundant field for the ingenuity of the engineer along this line of endeavor.



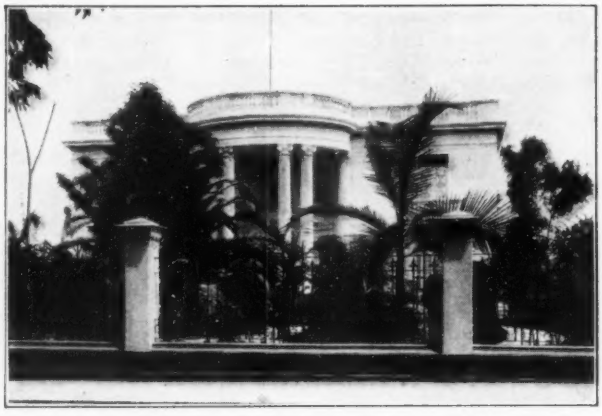


Interior of the *Martha Washington*. Most of the apparatus is underneath the car and that part of it which is inside is concealed or worked into the decorations. Arrows indicate the louvres for air delivery. *At top:* Re-circulation vents at kitchen end. The air passes over cooling coils and is re-delivered



Schematic diagram of air conditioning equipment, including piping

First glance at this Moorish type adobe house in Lima, Peru, would give the impression that it is of plaster



A home in Miraflores in the American colonial style. It is of adobe and might melt away in a heavy rain

Built of Mud

By A. HYATT VERRILL

WHEN we think of a mud house we usually visualize a mere hut or shanty, but in many portions of the world, mud, or adobe, is the principal building material. In the Orient, in sections of Europe, and particularly in Spanish America, buildings of adobe construction are the rule rather than the exception. Quite pretentious houses and other edifices are built of mud and, when stuccoed, whitewashed, or gaily painted, give no hint of the material of which they are composed.

In no other part of the world, however, has adobe construction reached such a state of development and attained to such heights as in Peru. Long ages before the Spaniards first set foot on Peruvian soil, the Incans and the pre-Incan tribes had learned the use of mud as a building material. Enormous walls, great mounds, countless dwellings, vast temples, and massive forts were built of the sun-dried mud bricks and blocks, and many of these still remain, little altered by time and the elements.

THE Dons followed their example and used the cheap and easily obtainable adobe in erecting their buildings. Their palaces, forts, homes, and churches were made entirely of adobe mud, and through the centuries these have endured and remain today as imposing and as beautiful as in the days of Pizarro.

It was left to the modern inhabitants of Peru, however, to carry mud adobe construction to the *n*th degree and literally to glorify mud. In and about the capital, Lima, is this particularly true. Of course, today, many of the business buildings, as well as residences, are of concrete or brick, but adobe still holds its own, and by far the greater number of Lima's homes, as well as a large proportion of its larger edifices, are entirely of mud.

In the days of the Conquistadors, the adobe bricks were merely piled one upon another to form the building walls, but today the usual method is to erect a light wooden framework and build the adobe upon this. In some cases metal frameworks have been used in connection with adobe. This method was employed in erecting the beautiful Rimac Building, perhaps the most elaborate mud building in the world. On the other hand, the world's largest mud building, the old Lima Cathedral, is built of adobe blocks without reinforcement of any kind.

A mud building that has stood for over three centuries. The Torre Tagle Palace

Apparently there are no limits to what may be accomplished with mud in Peru. There are charming, one-storied bungalows with wide verandas, Moorish palaces, imposing colonial mansions, Elizabethan cottages, Spanish mission homes, and even turreted castles, all built of the same sun-dried mud dug from the land on which the edifice is built. So great is the demand for adobe that everywhere, 'round and about Lima, one sees endless piles and high walls of the mud bricks. At first one thinks these merely boundary walls between properties, but it will be noticed that in nearly every case these walls are marked: *"Este pared no es medianera"*—"This wall is not a boundary."

ALSO, wherever there is available mud, one will see the natives industriously engaged in making adobe bricks.

The mud, dug from any convenient spot, is mixed with sand and usually with some chopped straw or dried manure. The resultant pasty mass is then pressed into wooden forms or frames. The shaped blocks are then removed and placed in the sun to dry and in a day or two are ready to use.

Brick making is a most

economical and inexpensive business for a man of limited means, or of no means at all. Provided he can secure permission to make use of the land, or a portion of its surface, for brick making—usually an easy matter, for the rental is taken out in completed bricks—the penniless brick-maker needs little more than his bare hands. With his wife and children, and all his worldly goods—which usually amount to nothing more than a few battered tins, and some hand-made stools—he camps upon the selected site. An ancient kerosene tin of water and a dilapidated shovel are produced. The dry earth is trod, dug, stirred, and worked into a thick paste; then some dry manure, gathered anywhere along the road, is added, and with all members of the little family helping, the bricks begin to take form. As soon as they dry they are piled in tiers.

In a few days the brick-maker and his family are surrounded by brick walls and are living quite comfortably and snugly in a little cavity left purposely for their accommodation. Here they remain as long as bricks can be made and sold on the land. And when an adobe building is in process of erection, the laborers invariably dwell within recesses in the piles of accumulated bricks—thus saving house rent—and tramp back and forth to their work.

WHEREVER a Cholo can find a mud-brick wall and employment, is "Home Sweet Home" to him, and often one may find a dozen or more families all dwelling in perfect contentment in their burrows in the piles of bricks where building is in progress.

In a damp or rainy climate, these dried mud-bricks would, of course, be worse than useless; and, should Lima be subjected to a few days of really heavy rains, most of the city and its suburbs would be reduced to the original, elemental mud. Several times within the past few years, various portions of Peru have been visited by unprecedented rains during the winter months, and great has been the havoc wrought. Around and about Trujillo, houses and churches melted like snow exposed to sunshine, and even the prehistoric ruins of the Chimu city of Chan Chan, which has stood unaltered for countless centuries, slumped and dissolved.

The fine old Cathedral in Lima, the largest adobe building in the world, built in the Sixteenth Century

To protect buildings from the drip from the eaves, practically all modern adobe buildings have several feet of the wall covered with concrete, while others have the lower portions of the walls built of stone, or stone and concrete. Even the old cathedral, which is not only the largest but one of the finest adobe buildings in the world, has been safeguarded with a concrete coating about the base of its walls.

Originally, too, the adobe buildings were all very much alike. They were massive, thick-walled, square, and usually of moderate height, were typically Spanish with iron-grilled windows, out-jutting carved cedar miradors, immense iron-studded and elaborately carved doors, and open patios. But with the modern improvements in adobe constructive methods, architecture appears to have run wild, and there is scarcely a type or style of buildings known to any part of the world the counterpart of which cannot be seen in or about the Peruvian capital.

Apparently the average Peruvian never has a definite plan in view when he starts building a house. He may start with a Spanish colonial form and by the time the first story is complete, he decides that the English style is better. He then adds a second story with exposed timbers, leaded glass windows, and stucco walls. Then to the steeply-pitched roof, he adds Spanish tiles, and among the chimney-pots erects a cupola where he can loll away many a hot evening.

HIS front door may be a graceful Moorish arch, but to put a finishing touch to the whole he adds the lofty pillars and severe portico of some Virginia mansion, and builds a *porte cochere* in Japanese style.

But with all his architectural failings, he loves color, and so paints his home in brilliant ultramarine, rose-pink, canary-yellow, or a combination of all. And, strange as it may seem, these architectural monstrosities do not strike a discordant note in the scheme of things. Surrounded by glorious flower gardens and magnificent pines and luxuriant palms, their bright hues are delightful, and one forgets their faults in admiration of the masses of roses and geraniums which clamber over walls and droop from the eaves.

And there are countless dwellings which are as charming and as perfect in their architectural features as one could wish.

Truly, the Peruvians have glorified mud, and by the same token, they have attained the utmost in building economy, for what could be more economical than to build one's home from the crude material dug from the land when excavating foundations or grading one's garden?

"Not a boundary wall." Piles of bricks ready for use and others drying in the sun at a native brick "factory"

Building an adobe house with a wooden frame. Construction is quite simple but the structure is substantial

Basic Patents in Evolution—I

By WILLIAM K. GREGORY

Professor of Vertebrate Paleontology, Columbia University. Curator, Departments of Anatomy and Ichthyology, American Museum of Natural History. Member, National Academy of Sciences

THE latest airship, crowded with powerful motors and directed by means of numerous instruments of precision, at first sight seems bewildering in its complexity; yet with a little assistance from the experts, one readily comprehends at least the general purpose and arrangement of its principal parts. The human body is vastly more complex than any airship, both in its locomotor machinery and in its instruments of precision; but at least the leading features of its construction and operation may be outlined with but little resort to the technical jargon of the anatomist and the physiologist.

In the case of the airship every mechanism and device doubtless has been developed from some earlier and simpler predecessor, which in turn rests eventually on one or more "basic patents," or primary inventions. An expert willing to search the records of the Patent Office could easily trace the steps in this evolution. Unfortunately, during the long ages when the "basic patents" of the engines of the human body were being tried out in Nature's testing grounds, no patent office records were being made. Nevertheless, the labors of several generations of comparative anatomists, paleontologists, and embryologists have enabled us to piece together the probable history of the human body by comparative methods, which do not differ essentially in principle from those that have been employed successfully by the archeologists or the Egyptologists in reconstructing the main sequence of historical events during long periods of time.

IT may be affirmed on good evidence that the skeleton of any given type of animal contains both a clear record of its present habits and a more or less obscured record of the habits of the earlier stages that led up to it. For example, the skeleton of a penguin (Figure 1, A) reveals many features, such as the paddle-like form of the wing bones, that are obviously connected with this bird's peculiar habit of "flying" under water. Yet many other features, such as the keeled breastbone, testify that the highly specialized and now flightless penguin traces its remote origin to birds that used their wings for flight in the air in the normal way. Again, the skeleton of a vulture (Figure 1, B) is beautifully adapted in very many ways for the habits of this bird of strong flight and predatory instincts. But it also abounds in other characters that have been inherited from the earliest reptiles that first began to skim down from the trees and flap their large skinny arms in the first feeble attempts at flight.

Examples could be multiplied of similar instances in which the "basic patents" acquired by earlier generations are transmitted, even though much disguised in external appearance, to remote descendants. In more technical language, the "habitus" (or totality of characters that adapt an animal to any given mode of life) may, under changed environments and habits, persist in part as the "heritage" of later times.

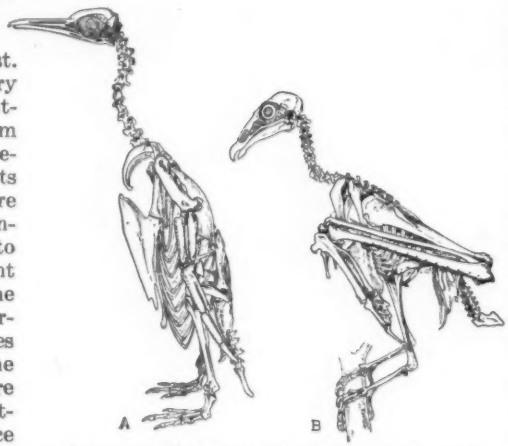


Figure 1: **Skeletons of penguin (left) and of vulture (right), showing swimming "habitus" of the penguin and strong-flying "habitus" of the vulture. Both retain many features in common, which constitute the primary "heritage" of birds**

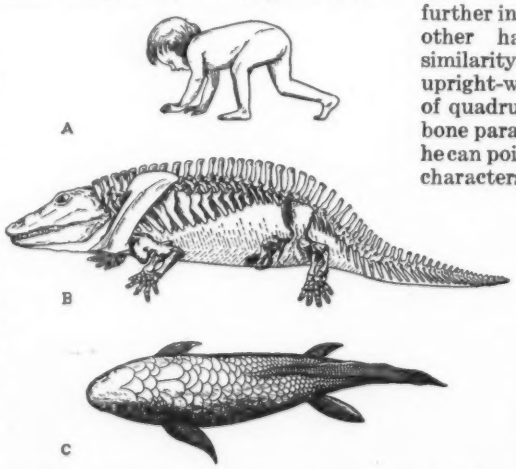


Figure 2: **Man's heritage from quadrupedal ancestors. *A* is a human infant running on all fours (after Hrdlicka). *B* is an ancient quadruped (*Eryops*) from the Permian age of Texas. *C* is an air-breathing fish (*Ceratodus*) with paired paddles corresponding to our arms and legs (oblique view from above) (after Dean)**

With this well established principle in mind, let us make a preliminary comparison (Figure 3) of the human skeleton with those of other animals for the purpose of determining its present "habitus" and of uncovering its prehuman "heritage." As to the "habitus" characters, even a cursory inspection of the human skeleton reveals the fact that it is beautifully adapted to support the body in the erect position, with the center of gravity a little above the points of support at the hip joints, immediately above the limbs. The human pelvis (the hip bones) is likewise fitted in many other ways to act as a bony anchor for the muscles that tie in the abdominal viscera, and as a base for the powerful thigh and back muscles that hold the body erect.

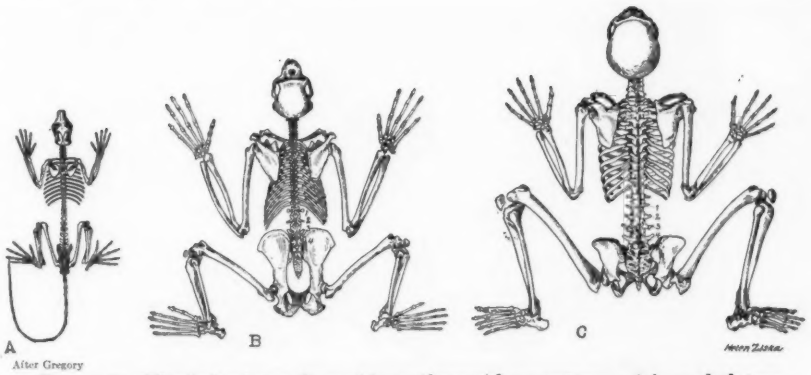
THOSE who believe in the sudden creation of Adam from the dust of the ground usually go no further than to say that such adaptations are part of the Divine Plan, and that the origin of this plan is one of the inscrutable mysteries of creation. But in practice such a philosophy usually blocks further inquiry. The naturalist, on the other hand, points to the basic similarity of the entire skeleton of upright-walking man to the skeletons of quadrupeds that run with the backbone parallel to the ground. Moreover, he can point to a long series of "heritage" characters in the human skeleton which appear to be inexplicable on any other scientific hypothesis than that man is a quadruped that has learned to walk on his hind legs (Figure 2). In the anatomical sense man is still a quadruped, since his fore limbs clearly correspond, bone for bone and muscle for muscle, with those of his nearest quadrupedal and semiquadrupedal relatives, the apes and monkeys.

To review even the main steps in the long ascent from fish to man would be too extensive an undertak-

ing for our available space, as the technical papers bearing on the subject run into many hundreds; but nevertheless let us attempt to notice a few of the many "basic patents" along the way.

There is not much use in inquiring here where the fish itself came from, for professional opinion hesitates between the "jellyfish" and the earliest sea-scorpions or eurypterids. But wherever he came from, the shark is already far nearer to man in his anatomical ground-plan than he is to any known animal that completely lacks a backbone. For this reason the humble dogfish, or small shark, is recognized everywhere as a veritable epitome of human anatomy, and all properly qualified pre-medical students find that dissection of the dogfish gives them a welcome clue to the anatomical intricacies of their future patients.

LET us consider first the shark's locomotor machinery and then inquire what parts of it are still recognizable in human anatomy. The "basic patent" of the entire locomotor machinery of the shark is the striped, or voluntary, muscle fiber (Figure 4). The mechanism of this simple-looking little thread is slowly yielding its secrets to the siege of the physiologists. The muscle fiber has been broadly characterized as a "tiny gas engine," but it differs from an ordinary gas engine in using its oxygen in the recovery stage rather than in the work-producing stage. Vast numbers of the red muscle fibers of the shark are grouped in broad zigzag zones called myomeres, or muscle segments, arranged in tightly packed rows along the sides of the body. The ends of the muscle fibers are fastened to the connective tissue partitions that both separate and connect adjacent myomeres. By means of the delicate nerve fibrils that run to each red muscle cell the contraction of the myomeres is timed so that a wave of contraction runs along the side of the body from front to rear. But soon after the first wave starts along the body, a second begins on the opposite side, then a third on the same side, and so forth. By this very simple device the body of a long-bodied fish is itself thrown into a series of backwardly-passing waves, which by their reaction against the water, drive the fish forward.



After Gregory

Figure 3: **Man's heritage from his anthropoid ancestors. *A* is a skeleton of an ancient fossil primate from the Eocene age. *B* is a skeleton of a chimpanzee. *C* is a skeleton of man, placed in the same position as *A* and *B***

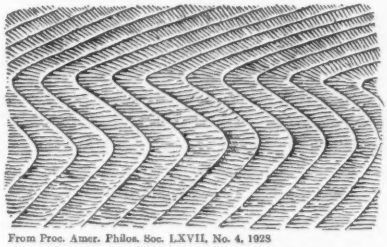
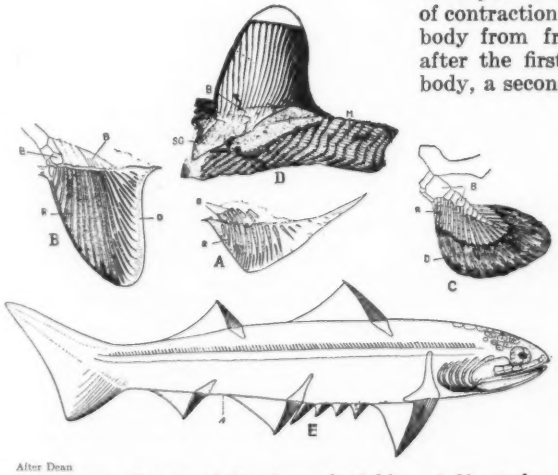

From Proc. Amer. Philos. Soc. LXVII, No. 4, 1928

Figure 4: **Diagram of arrangement of muscle fibers as shown on the inside of a piece of dried shark's skin. In this "basic patent" of the locomotor machinery of all vertebrates from shark to man, the horizontal red muscle fibers are attached to zigzag connective tissue partitions, or "myosepta," the whole W-shaped muscle segment forming a "myomere"**



After Dean

Figure 5: **Origin of fins from fin folds. *A:* Ventral fin of Devonian shark (*Cladoselache*), showing separate rod-like supports of "fin-fold" fin. *B:* Pectoral fin of the same, showing pectoral girdle and basal pieces presumably derived from fusion of separate rods. *C:* Pectoral fin of Permian shark (*Pleuracanthus*), showing fully developed paddle-like fin with jointed axis. *D:* Pectoral fin of Devonian shark (*Cladoselache*), partly covered by preserved myomeres. *E:* Restoration of generalized shark**

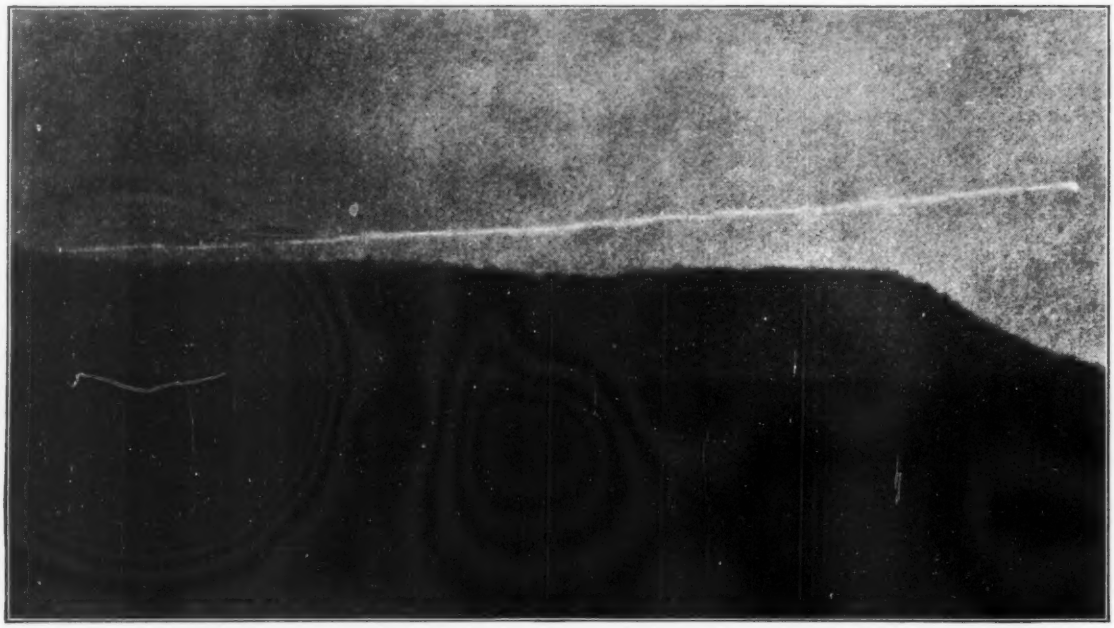
This simple arrangement was also the starting-point for the most complex locomotor machinery of the higher vertebrates. The zigzags of the myomeres soon lose their primitive simplicity. In some sharks, as we pass along the side of the body toward the tail, the tips of the zigzags become greatly prolonged and the connective tissue sheaths of corresponding tips of successive zigzags tend to adhere and unite so as to produce tendons that transmit to the tail the pull of the less modified muscle segments farther forward. And in higher fishes those parts of the muscle zigzags that control the movements of the pectoral fins often fuse into compound muscles that clearly suggest the muscles that move the limbs in the higher vertebrates.

The fins in the most ancient and primitive known fishes, the sharks of the Devonian period (Figure 5), were merely stiff folds of skin which were slightly warped by the zigzag muscles of the flanks, and mainly served as keels and rudders to steady and direct the forward progress of the fish. In some of the higher fishes, on the other hand, the bony rods that supported the paired fins fused into a skeleton that appears to have been the starting-point of the complex shoulder-girdle and fore limbs of land-living vertebrates. The pelvic fins of fishes bear even clearer traces of their derivation from keel-like fin-folds, the bases of which became invaded by outgrowths from the segmental muscles of the body (Figure 5, A).

DURING the embryonic development of all higher vertebrates, including man, the fore and hind limbs develop from bud-like outgrowths involving folds of skin from the body wall and an extension of the segmental muscles of the flanks.

In short, the detailed evidence of comparative anatomy leaves no substantial doubt that upright-walking man has derived all four of his limbs from the corresponding organs of some early four-footed animals, that these quadrupeds derived their limbs from the paired paddles of certain types of air-breathing, lobe-finned fishes, and that they in turn derived their paddles from the simple fin-folds of still earlier shark-like fishes. Such were the "basic patents" of our motor system.

(To be continued)



It is a commonplace that we "see the sun after it actually has set," due to the bending of its rays (atmospheric refraction) by the earth's atmosphere. Above is a photograph of the trail of the star *Alpha Centauri*, made by time exposure in a 24-inch fixed telescopic camera by Professor W. J. Luyten of Harvard's South African observatory. The star dips behind the theoretical horizon by as much as the diameter of the moon, yet is visible above it due to refraction. The telescope, of course, is not moved

The "Green Flash" and Other Odd Phenomena

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

As one watches the setting sun, it sometimes takes strange forms. Always when it is low on the horizon it appears flattened, with its vertical diameter considerably shorter than the horizontal, and just before the lowest point of the rim disappears it may be noticed that the lower half of the disk appears more flattened than the upper. These are normal phenomena which can be seen whenever clear weather and the free horizon permit, but not infrequently—especially when the sun goes down into the sea—its shape may seem strangely distorted. At times the lower half may look larger vertically than the upper, so that the partly set sun looks like a Chinese lantern. The likeness often is emphasized by the appearance of little corrugations in the outline of the upper dome-like half. On other occasions the top of the sinking sun, instead of disappearing quickly, seems to hang on the horizon as a fine horizontal line of light.

It is not the sun alone which shows these strange vagaries. A distant coastline may look distorted. Low sand banks sometimes seem expanded into high cliffs or a long line of distant coast which normally runs out at the horizon, may seem to end in the air with a narrow line looking like sky, separating it from the sea surface below. Ships on the horizon or beyond it, too, are often absurdly distorted, so that only the experienced sailor long familiar with the effects of what he calls "looming" has any real idea of what sort of craft it may be at which he is looking.

MOST remarkable of all are the things that are seen upon the desert.* A level stretch of hot sand may appear to be covered with water, reflecting not only the sky but the barren hills beyond and producing a perfect illusion—as the writer has seen it within a few days on the sandy wastes of Nubia.

These more conspicuous phenomena, whether on land or sea, are grouped under the general name of mirage. Though visible and sometimes conspicuous to the unaided eye, they usually show up better with a field glass of low power. But when a high-powered glass is used—much more a telescope—the image is found to be so blurred and trembling that very little can be made out. Just at the edge of the mirage, indeed, the bad definition is often perceptible even by the naked eye.

All this is interesting, surely, to the traveler but what has it to do with astronomy? "Much every way," as Saint Paul once said—it is the most spectacular exhibition of something with which the astronomer has to reckon in all his observations—namely, the refraction of light in the atmosphere.

In empty space all the waves of light travel with the same standard speed but in air they are retarded, and the more so the denser the air. As a result the "rays" of light—that is to say lines drawn at right angles to the waves and indicating in what direction the

*Dr. Russell's article was written in Egypt, where he had just seen some of the phenomena described in it.—*The Editor.*

latter are moving—are usually curved when passing through the air, instead of straight as they are outside in space. One simple rule suffices for an understanding of most of the numerous effects of such refraction. The rays of light always curve toward the side on which the air is denser. Why this happens can be seen at once from Figure 1, which represents a number of successive positions aa′, bb′, and so on, of the crest of a light wave. The air is supposed to be denser toward the bottom of the picture than toward the top, hence the distances ab, bc, and so on, through which the light wave moves, will be greater than a′b′, b′c′, and so on (the effect is of course vastly exaggerated in the figure). The rays of light XY and X′Y′, which are drawn so as to be always at right angles to the waves, will therefore curve downward; that is, toward the denser air.

UNDER normal circumstances the air grows steadily denser downward from great heights to the earth's surface. Hence the rays of light curve downward and the direction in which they enter our telescope or our eyes is altered so that we see the sun, moon and stars higher in the sky than they would appear were there no atmosphere.

The more obliquely the rays traverse the air the greater is this effect. At considerable altitudes the shift of apparent position by this "astronomical refractor" is not very large—about a minute of arc at 45 degrees altitude. In all accurate observations, of course, it must be carefully allowed for—which is laborious since its amount varies with the pressure and temperature of the air. Near the horizon the refraction becomes large, amounting at rising and setting to more than half a degree. For bodies only a little higher, its amount is considerably reduced. When the sun is setting, therefore, the rays from its lower side are more curved than the less oblique rays from its upper side, the lower limb appears to be raised more than the upper, and the disk seems flattened. It may be noted in passing that refraction makes the sun set later than it would otherwise do, and rise earlier, since it raises the sun in both cases, so that the day gains about 5 minutes in length in temperate latitudes at the expense of the night.

Before leaving this normal refraction we may mention an interesting effect which, though of the "second order" depending on small changes in a quantity which itself is usually small, can be easily observed without instruments.

Shorter waves are more slowed by air than longer ones, and hence the rays of red light are curved least and the violet most. When the sun is low, therefore, it appears to be raised a little higher if seen by green light than by red, and if viewed through a telescope its disk shows a greenish border at the top and a reddish one at the bottom (the violet is always lost in coming through so great a thickness of air). This border is far too narrow to be seen by the unaided eye, but just as the sun sets the green image remains in sight for an instant after the red and yellow have disappeared, so that under favorable conditions the last speck of sunlight can be seen to turn from yellowish red to green.

This "green flash" (Figure 2) is a normal phenomenon and can be seen unless something interferes. Unfortunately a good many things may interfere. The air, of course, must be clear and free from haze. There is little hope of seeing it unless the setting sun looks yellow rather than red, and is too bright to look at without dazzling the eyes. The horizon must be fairly distant, sharp, and at a low altitude. A sea horizon or a low distant range is the best. Finally the eye must not be fatigued by gazing at the brilliant disk before it sets. A mere glance now and then to see how things are going is all that the observer should allow himself until hardly more than a speck of the sun remains. Granting these conditions the green flash is visible under a great variety of conditions. It is better seen with a field glass than without. At sunrise, of course, it is equally well visible, with the advantage that the eye is not tired, and the disadvantage that one must keep a sharp watch not to miss it.

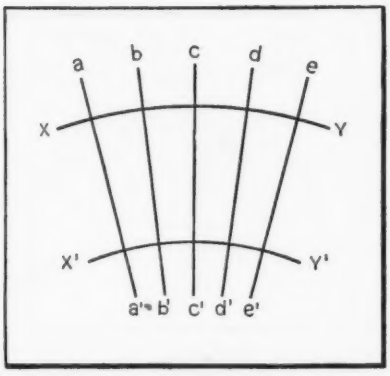
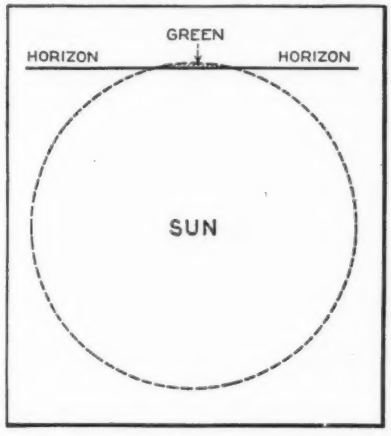


Figure 1: **Explaining the cause of refraction or bending of light. See the explanation in the text**



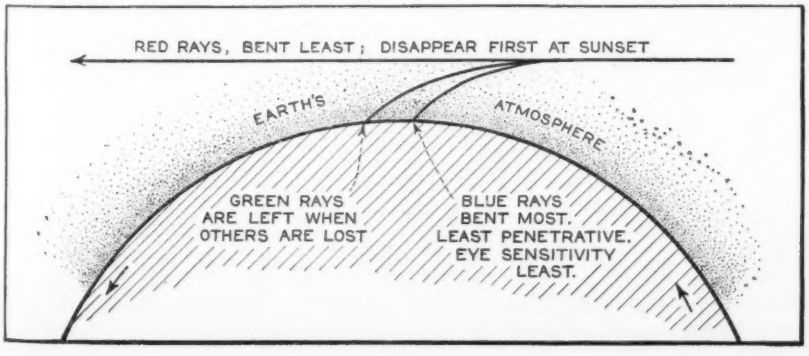

RED RAYS, BENT LEAST; DISAPPEAR FIRST AT SUNSET
EARTH'S
ATMOSPHERE
GREEN RAYS ARE LEFT WHEN OTHERS ARE LOST
BLUE RAYS BENT MOST. LEAST PENETRATIVE. EYE SENSITIVITY LEAST.

Figure 2: **The phenomenon of the green flash is not especially spectacular; it occurs when less than 1/100 of the disk remains in view (right). Below is the explanation of the effect (diagrammatic)**

MIRAGE, including in this term all the protean forms of distorted images of celestial and terrestrial objects, arises from abnormalities of refraction mainly if not entirely due to irregular distribution of temperature within the air. The normal and gradual increase of density downward is due mainly to the increase of atmospheric pressure. To be sure, the air is warmer low down than higher up; and this works the other way, though under ordinary conditions to a much smaller degree than the change in pressure.

When, however, the earth's surface, whether land or water, is considerably hotter than the air at large and the weather is cooler, a thin layer of air just above the surface may be heated so much that it becomes considerably less dense than the overlying cool air, even though it is at a slightly higher pressure. Rays of light passing through this stratum will be curved upward, as illustrated in Figure 3, which shows how the illusion of a sheet of water filling a desert plane will be created. The distant object A is seen by the observer at O, through the upper layer of normal air, by light which follows the path AaO, which is curved very slightly downward. Light rays traversing the layers of hot air near the surface indicated by the lower lines will

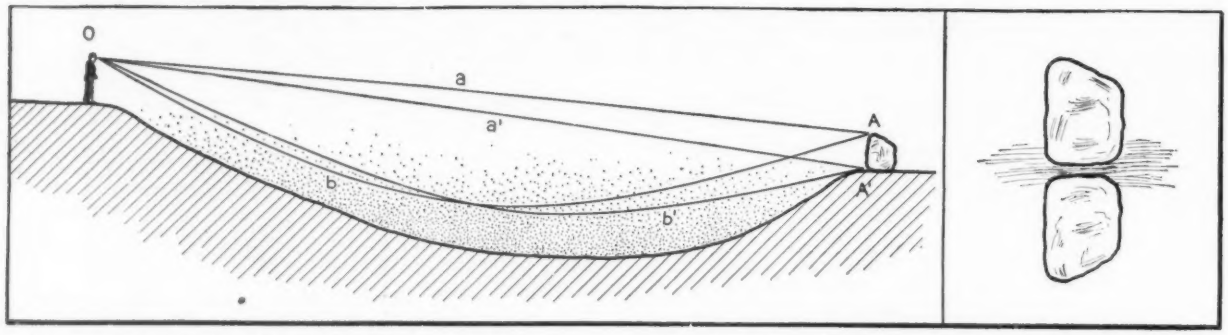


Figure 3: **Explaining the familiar illusion of a lake on a desert, also at right the rock at A is seen doubled, a "superior mirage"; see Humphrey's "Physics of the Air," standard work in which peculiar phenomena are treated**

be curved strongly upward so that the observer may see a second image of A, caused by light which has followed the path AbO. The base A′ of the object will be seen both along the rays A′a′O and A′b′O, so that the observer will see two images, one erect and in its normal position and another inverted and lying below it as if reflected in a sheet of water filling the valley.

Mirages appear most typically under two very different conditions: first, on land where the bare surface of the ground is highly heated by the sun, and secondly at sea where the vicissitudes of the weather bring cooler air over warmer water. The first situation is characteristic of desert regions, but one need not go to the borders of the Sahara nor to Death Valley to find it. Almost any bed of level railroad track on a calm sunny day will suffice, and a stretch of level oiled highway still retaining the heat of the sun though the air above has cooled after nightfall, does even better. Most of us have seen a distant locomotive looking twice as high as it should, and it is a common thing looking from an observation tower to see the space between the rails apparently filled with water. Almost all of us, too, have seen the lights of an approaching car half a mile or so away apparently refracted from the pavement of the road; and all these are as truly examples of mirage as the proverbial "lakes" in the desert.

ALONG our coasts, too, when the autumn days and evenings are cool and the water still retains its summer heat, distant shores seem lifted into the air, ships are strangely distorted, and far-away light-houses show double lights one above the other. No one can live long by the water without seeing these things, but not so many understand them.

Another effect of these anomalies of refraction is that the distance of the horizon at sea, or of the farthest objects that are visible on land, may be very different on different days, or even at different hours of the same day

How this happens is again best understood from the diagram. Figure 4 almost explains itself. In the absence of refraction the rays of light are straight and the horizon at A. When there is a stratum of hot air close to the surface the rays curve upward and the horizon is nearer at B, but when the air near the surface is abnormally cold the rays curve downward and the horizon is shifted to C.

It is clear from the figure that not only the distance but the apparent direction of the horizon is altered. As a result the dip of the horizon, for which allowance has been made in all observations, may differ perceptibly from the standard value given on the tables employed by mariners. The error arising from this cause is often a good deal larger than any other which occurs in careful observations with a good sextant, and it sets a limit to the accuracy of determination of longitude and latitude at sea; but fortunately the uncertainty arising from the cause is usually less than the distance which the ship would run while the captain is "working his sights," and so it is not of practical importance.

THE diminished distance of the horizon under mirage conditions is not very noticeable, but the increase when the air is cold close to the ground may be very remarkable. On the Texas prairies, where the ground is as level as the sea, and distant buildings look like ships "hull down," the writer has seen just before sunrise houses and farms which were ordinarily quite invisible. Within a few minutes after the sun's rays warmed the ground these began to settle down into the horizon and before long they had quite disappeared. Under these conditions in clear weather the mariner may see light houses which normally would be far beyond the horizon.

The most remarkable instance of refraction which the writer has seen happened one afternoon in a New England harbor when the sea horizon was clearly visible above the top of a house on an outer beach, although the observer in a small motor boat had his eyes less than six feet above the water. In this case the downward curvature of the rays must have been so great that, although passing above the house (fully 30 feet above sea level), they bent down to the water within a few miles on each side.

IF the layers of warmer air were horizontal and absolutely calm the reflected or distorted images of a mirage would be sharp and clear, but even in the stillest weather there is always more or less stirring of the air, if only by currents arising from the hot ground, and this turbulence confuses and disturbs the images so that they bear at best only a low magnifying power. This is but an extreme instance of the "bad seeing" which is always more or less present and is so troublesome to the telescopic observer. If the atmosphere were visible like water, its turbulence then would be far more impressive than it is. In comparison the wild turbulence of Niagara Rapids would seem quite tame.

All the phenomena of atmospheric refraction, whether normal or abnormal, are an unmitigated nuisance to the astronomer but they are so varied, so curious, and so easily to be seen if one is on the watch for them that some knowledge of them may add interest and pleasure to a summer vacation.—*Luxor, Egypt.*

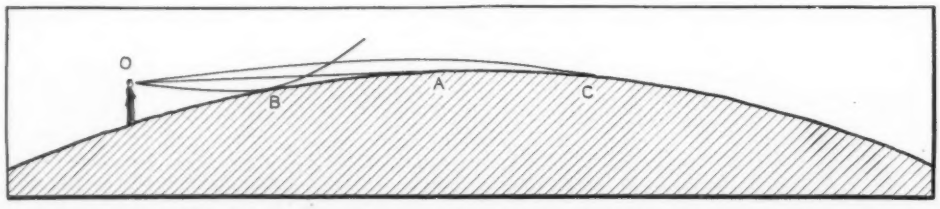
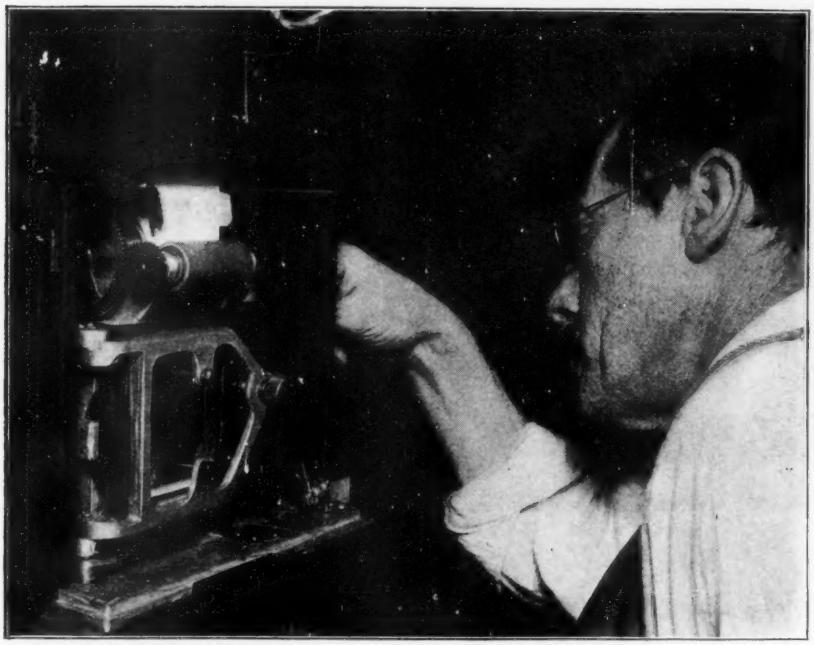


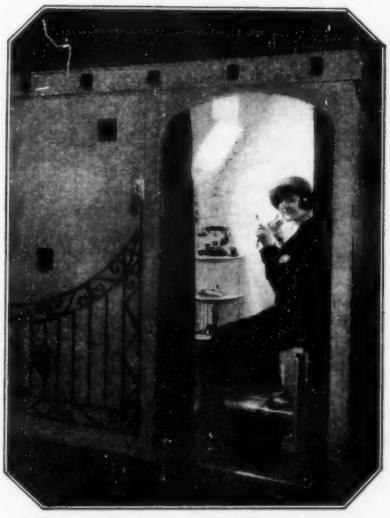
Figure 4: **Why different temperature effects cause the horizon to vary in distance**



The electrical photographing mechanism is automatic. The photograph is taken through a screen and it, in turn, is viewed through a screen

Film Yourself for a Quarter

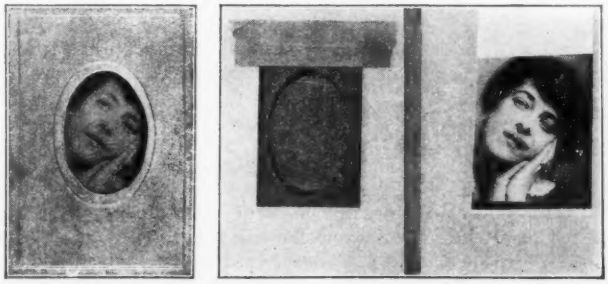
THE theatrical business is precarious at best and "flops" are common so that there is little wonder in a producer taking a flyer on stocks or in an invention, particularly in something which has a very popular appeal. Mr. A. H. Woods is one of these producers who is backing a very clever device that makes simulated motion pictures of subjects while they wait. Mr. Woods obtained the rights in an English invention a few years ago but the time required to produce the picture was inordinately long. For the past two years Mr. Stanley J. Pask, a practical camera man, has been making the device commercially marketable. The pictures may be radically different—thus you may smoke, use a telephone, or take a group of a family of three, and each can be animated in turn.



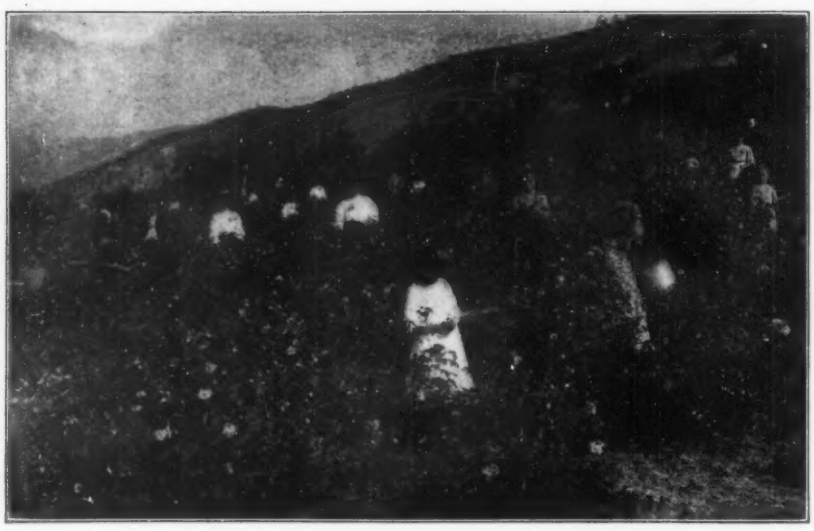
The would-be movie star sits in the booth and the face is well lighted

The new camera is very complicated and only a brief outline of the cycle of operations will be given. Three (or more) pictures are taken on one plate film through a screen composed in part of transparent material and in other parts, of opaque material. The screen is positioned directly in front of and resting against the sensitized film and with the object to be photographed focused properly in front and illuminated by a powerful electric light, so that at least three exposures may be made. The screen is shifted at each exposure, the person being photographed changing position. The person sits on a stool in a booth fixed up like a dressing room. The idea is to take the photographs so that they will give some idea of how he or she will "screen."

ONCE in position the attendant presses a plunger and the cycle of operations begins. After the three exposures are made, the sensitized film is developed automatically in the machine in 12 seconds and we have what appears to be an ordinary photograph except that it is ruled with almost invisible vertical lines. This is mounted in a pasteboard frame 2⅜ by 4 inches and a cover of the same material is provided with a cut out window to which is attached a vertically ruled film. The two pieces of cardboard, one holding the photograph and the other the film, are loosely attached so that there can be lateral movement. If the sides of the mount are pinched slightly, the picture is "animated" giving the effect of a moving picture, which is most amusing. These booths will soon take their places where amusement devices are shown, and in theater lobbies.



At left is picture ready to be "animated." In center is the cover with the ruled screen and to right the photo



Gathering petals for perfume in the Balkans. Egypt, too, produces fine flower oils to a growing extent

Perfume

By MARTIN MEYER, Ph.D.

Assistant Professor of Chemistry, College of the City of New York

THE sense of smell is one of the human functions which not only has failed to advance with evolution but which in many respects has actually deteriorated with the increase of civilization. The dog distinguishes friend from enemy by the smell, and can track a man over a long period from the mere recollection of the odor of one of his articles of clothing. Wild animals scent danger at incredible distances where no explanation save smell or intuition is forthcoming.

The human animal no longer possesses this delicate perception. He can distinguish agreeable odors from disagreeable ones, but the very language itself expresses the atrophy that has occurred. One does not have to be exceptionally well skilled in the use of words to be able to describe a scene so accurately that another who has seen it will recognize it or, not having seen it, would later feel familiar with it. With a smell, however, this is quite impossible. Try to depict in words the most familiar fragrance, that of the rose, for example, so that a hearer will know it, without employing words such as "rose-like," which suggest the object described. Your effort will certainly be a failure.

Perfumes are solutions of essential oils and other fragrant materials in slightly diluted alcohol or spirits, while those of the ancients were merely the odoriferous materials themselves.

Essential oils are interesting substances indeed. They are all obtained from vegetable sources, occurring in the flowers, leaves, stems, and roots of plants, and are extracted by highly ingenious methods. They derive their general name from the fact that all are oily materials in the sense that they are usually lighter than water and float on its surface but do not mix with it. They also resemble other oils in that they will form a greasy spot on a piece of paper, but they differ from the so-called fixed oils, in that this spot disappears or evaporates completely on standing, whereas the others do not. Not all have pleasant or even agreeable odors.

OTHER perfumery materials, and some of the most expensive, are obtained from animals. Ambergris, a highly prized perfumery component, is found occasionally in large lumps on the seashore, washed in by the waves. It is a material emitted by sick whales. Musk is obtained from a variety of oriental deer, now nearly extinct, because of the merciless hunt for it, and civet, another valued fragrant essence, from a member of the cat family, in ways that have nearly exterminated the species.

Some of the flowers yield their essential oils simply by pressing the petals, but the yield is extremely small. A ton of flowers may give only an ounce or two of the desired perfume material. Other oils may be obtained by extracting them with alcohol or other solvents.

Steam distillation is yet another method employed in coaxing flowers to yield the secret of their gorgeous fragrance. The flowers are macerated with water, and then steam is passed through the mixture and the escaping vapors are condensed. The essential oil floats upon the surface and can be separated and used in making perfumes, while the residual water itself retains enough of the oil in solution to be highly fragrant and has commercial value. Oil of roses can be made in this way, and the remaining liquid is sold as rose-water. In France they employ an interesting process termed *enfleurage*. In that land, growing flowers is a branch of agriculture conducted on a scale comparable with the raising of the cereal grains. One of the greatest beauties of southern France is the large flower fields in bloom. Fats and oils possess the property of absorbing odors to a marked degree; every housewife knows the result of placing butter in the icebox with fish, and in *enfleurage* the petals of the flowers in full bloom are packed in a box on shelves between pans of a very pure fat which slowly absorbs this fragrance. The essential oil then may be extracted from the fat and used for perfumes, or the fat itself may be made into pomade. The yield of essence by this method is extremely small but its quality is very high.

ESSENTIAL oils and perfumery materials are high-priced articles of commerce but they rarely reach the retail trade. They are made or purchased by the manufacturer of perfumes. In price they vary from a few dollars an ounce to hundreds of dollars a pound, and many of them are literally worth more than their weight in gold. Perfumes are made by dissolving them in alcohol, and as a rule a perfume does not contain more than 10 percent by volume of essential oil.

Usually perfumes do not consist of a single essential oil dissolved in alcohol. Therein lies the secret of their manufacture, for the blending of the oils to make the commercial odors is a delicate art and a closely guarded secret of the firms which have become world-famous. Some of the formulas, such as the famous German Cologne water, have been in the sole possession of single families for generations and to obtain them is impossible. They are available neither in the interests of science nor for any price.

A chemist named Piess once devised the interesting scheme of likening the odors to the musical scale, and made up a keyboard on which the lower notes were represented by the heavy oriental odors such as patchouli, ylang-

ylang, and sandalwood, rising to the lighter and more evanescent ones like rose and heliotrope. On this fascinating scale one could play odor symphonies like a musician, for musical accords represented agreeable combinations, and discords incompatible mixtures. The device was, of course, purely of academic interest for there is no mechanical rule by which perfume formulas can be originated. Mixing of essential oils to form fragrances which will strike the popular fancy is an art requiring a delicacy of perception that doubtless can be acquired only by long experience.

The manufacture of perfumes is a field in which the chemist finds a very agreeable opportunity to display his talent and his ingenuity, and he already has done so with a marked degree of success. Usually the chemical laboratory is a place distinguished by odors that are proverbially vile beyond description. The perfume laboratory is truly a garden of roses, for practically every material which enters into their manufacture, as well as the perfumes themselves, have highly aromatic agreeable odors.

WITHOUT the chemist, perfumes would still be far too expensive to be used as generally as they are, even though they are still relatively costly. The cheapest of them which contain any considerable quantity of natural essences sell for three to five dollars an ounce, and 25 dollars is not unusual.

In the case of the most expensive of all, the rôle of the chemist is best illustrated. Natural violet perfume is the rarest and most costly of all the fragrances in the perfumer's bouquet. An acre of violets yields only a few drops of the essential oil which is this essence, and it is exceedingly difficult to obtain and keep. By careful analysis it has been determined that the chief component of violet oil is a chemical substance called ionone. When pure, this material is so powerfully fragrant that it paralyzes the sense of smell completely and seems odorless, a phenomenon which is not unusual with strong solutions of highly odoriferous substances. Synthetic organic chemistry has shown how to make ionone very cheaply and violet perfume so made is now among the cheapest of all. This is so true that natural violet perfume scarcely can be obtained, for it can not compete with the five-and-ten-cent-store variety with which the untrained taste, or rather, smell, so easily confuses it.

Among the other triumphs of the chemist of a similar nature have been methyl salicylate, identical with the chief component of natural oil of wintergreen; coumarin; geraniol, characteristic of roses; citral; musk; and many others. The products of the chemists' laboratory can not, however, be used alone in any but the cheapest perfumes. While they have very powerful odors identical in many cases with the principal substances in the natural essential oil, the discriminating sense can easily distinguish the many other components which shade so delicately the perfume made from a natural flower.

THESE do, however, make perfumes cheaper to manufacture because they can be used to replace part of the true essential oil, which then gives the bouquet which surrounds and enriches the principal odor. Practically no perfumes as sold today are without synthetic organic products, yet on the other hand, none, save the very cheapest, is completely synthetic.

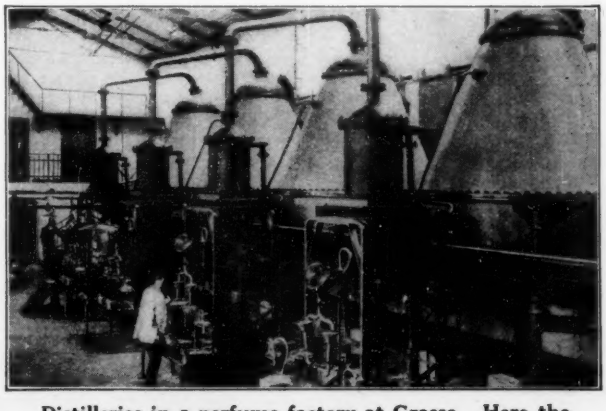
Relatively few people seem to enjoy the fragrance of a perfume with the true appreciation of a connoisseur yet, like the taste of tobacco or the fine bouquet of a wine, the appreciation of which is almost a lost art in America, it is easy with care to perceive the extremely nice shades of odor which distinguish the higher grades of perfume from each other. This is especially uncommon and enjoyable in the case of popular odors which are blends not characteristic of any one flower. Frequently I have experimented with women who have used the same and expensive odor of perfume for many years. After modifying the perfume so that the chief odor remains the same, as well as the color, though the difference was easily perceptible to one who had carefully observed, I have presented it to them in the expected package and bottle, and they often not only fail to detect the deception, but compliment me upon the fact that it appears fresher because it is stronger and more lasting. With age perfumes do change in color and in odor.

IT is interesting to note that here, too, as in the case of any rare and expensive commodity, the practice of bootlegging flourishes and is very profitable. Rare ingenuity is sometimes exhibited, running from the comparatively crude device of diluting the original perfumes with alcohol and cheaper perfumery materials, to complete and spurious imitation of the original product. In the case of two or three internationally known perfume manufacturers, especially in purported re-bottled perfumes, this has been perpetrated so extensively and unconscionably that it has damaged considerably the widely advertised and wholly deserved name.

Careful chemical study established the nature of the devices used and strenuous methods have been adopted to stop the deception, but if the public which, in general, detected it only where the perfume became so dilute as to be not at all lasting, would cultivate a more refined sense of smell, this would be much more difficult. One would think that this would be done by people who are willing to pay 25 dollars for an ounce of material, the use of which, without such artistic perception, is like casting pearls before swine.

¶ This is the third and last of Dr. Meyer's very interesting and instructive series of articles. It is hoped that at some future date other popular articles, equally interesting, may be written by this author.—*The Editor.*

Detaching petals from rose blossoms in a factory at Grasse, near the sunny Riviera, in Southern France



Distilleries in a perfume factory at Grasse. Here the detached rose petals surrender their fine fragrance

The Eight-Inch Gun Cruiser

By CAPTAIN W. D. PULESTON, U.S.N.

At the close of the Revolutionary War the Continental Navy was disbanded. Due to attacks of the Barbary pirates on our commerce in 1794, Washington recommended and Congress authorized the construction of six frigates. This was our first building program as an independent state. General Knox, Secretary of War and Navy, decided that these frigates "should combine such qualities of strength, durability, swiftness of sailing, and force as to render them equal if not superior" to any European frigates. The results of the battles between frigates during our wars with France and England indicated that American designers measurably succeeded in their object. President Roosevelt voiced the same idea in his demand that the American Navy "ship for ship" must be better than any other in the world.

The era of wooden ships culminated in two principal naval vessels—ships of the line displacing 1300 to 3100 tons, carrying 60 to 120 guns, and maximum speed of 12 to 13 knots; and frigates displacing from 650 to 1300 tons, carrying 32 to 50 guns and capable of outsailing the ships of the line, except in heavy weather. In addition to these were sloops of war and fire-ships corresponding to our light cruisers and destroyers, and bomb-ketches especially designed for use against shore defenses.

The advent of the steam engine, the paddle-wheel, and the screw propeller gradually gave a reliability to naval motive power entirely lacking in the sailing vessels. The iron and steel industry furnished the naval designer with material that permitted greater freedom in design than wood.

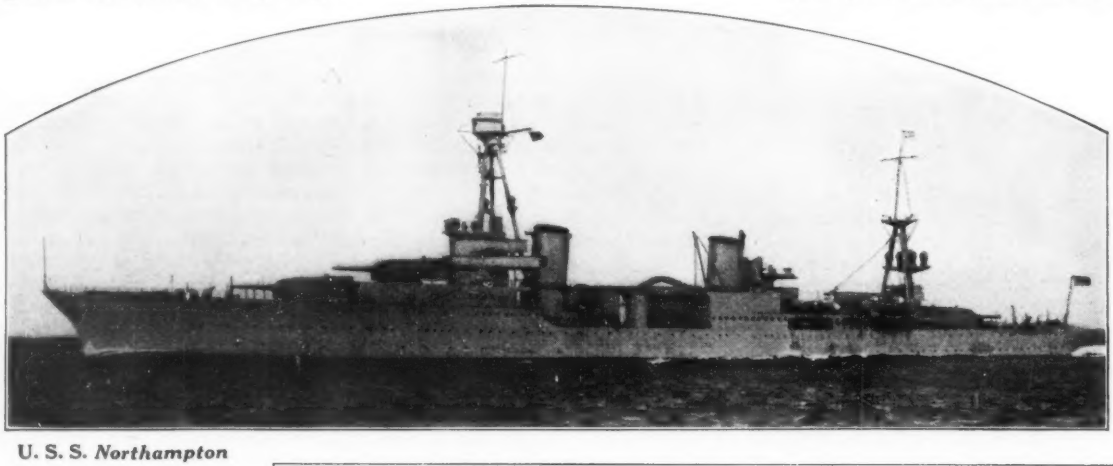
The great advantages of seapower were early known to Europeans, and modern European states, particularly from 1870 onward, demanded navies, and gave an increasing impetus to naval design that continued to the Washington Conference in 1921-22.

The weapon builders and the armor manufacturers responded to the urge, and the development of the gun, the mine, and the torpedo, and the improvement in armor and compartmentation of ships, proceeded apace. After the Spanish-American War we began to build a fleet. The submarine and the airplane made their appearance to complicate the task of the naval designers further, and the World War accelerated the natural rate of improvements of all naval weapons and vessels as nothing else has ever done.

For over a century of design, naval constructors generally and American particularly, following the idea of General Knox, have struggled to obtain three almost unattainable attributes—invulnerability, omnipotency, and omnipresence. They sought an unsinkable ship, an irresistible ship, and a ubiquitous ship. Together with their ordnance and engineering designers, they strove to create a ship that could resist any other, run down any other, and sink any other ship. In the same plant, the ordnance manufacturer would seek to develop impenetrable armor and an armor-piercing projectile.

THIS competition led to continued increase of tonnage because designers soon discovered increased size gave them a still greater corresponding increase in offensive and defensive values. There naturally followed a constant increase in size of all types of ships.

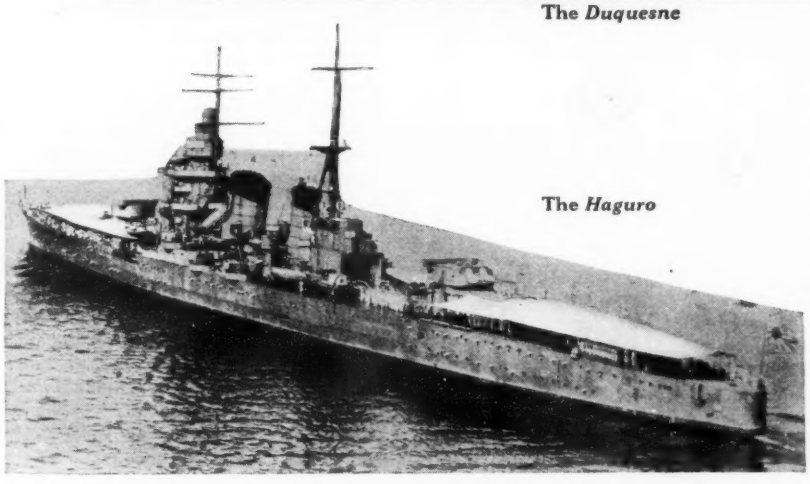
Mahan's widely read books on the advantage of command of the sea spurred the great powers, particularly Great Britain and Germany,



U. S. S. *Northampton*

H. M. S. *London* ➤

The *Duquesne*



The *Haguro*

to renewed efforts and the first decade of this century saw an enormous development in naval strength. Until Admiral Sir John Fisher became First Sea Lord of the British Admiralty, design proceeded generally on the tentative system, following a step-by-step development. Fisher brought in the dreadnought type of battleship and battle cruiser, and led the world in the pre-war design; other countries quickly followed his example. The British pre-war design culminated in the battleships of the Royal Sovereign class, the battle cruisers of the Tiger class, and the so-called battleships of the Queen Elizabeth class whose 25 knots made them practically battle cruisers. The progressive design of battleship and battle cruiser almost met in the Queen Elizabeth class, as shown by the following table:

	Tons	Speed	Guns	Armor	Protective Deck
Queen Elizabeth	27,500	25	8-15"	13"	1" to 3"
Tiger	28,500	30	8-13.5"	9"	1" to 3"

This table also shows the great cost of the last few knots; thus for five knots extra speed, the battle cruiser *Tiger* conceded the *Queen Elizabeth* 4 inches of armor belt and 15-inch guns instead of 13.5 inches.

In the naval competition between Great Britain and Germany, neither state made much effort to conceal the fact that they were building against each other and expected to fight in the North Sea. In fact, one of the main reasons for Fisher's designing the dreadnought class was that Germany, until she deepened the Kiel Canal, was at a handicap in this deep-draft class.

American designers have to build their vessels for service in all parts of the world; and with no hereditary enemy, they have to design vessels for more than one purpose and fit them for duty in any part of the world.

OUR 1916 naval program provided for ten superdreadnought battleships and six battle cruisers. We kept our battleship types quite distinct from the battle-cruiser type, not attempting the great increase in speed in our battleships attained by Great Britain. So did Japan, although generally speaking, the designed speed of her battleships has exceeded ours.

The first modern limitation on the size of all naval vessels was the dimensions of the locks of the Panama Canal. This fixed absolutely the maximum outside limits of American ships and practically fixed it for other navies that will probably find the Canal useful, if not essential.

The Washington Conference placed the next limitation on naval design by creating a battleship holiday and by limiting cruiser displacement to 10,000 tons and armament to guns of 8-inch caliber. The battleship holiday, recently renewed at London, increased the importance of cruisers, destroyers, and submarines, and naval constructors concentrated their attention on the designs of these and aircraft carriers. The limitation placed on the tonnage and caliber of guns to be carried on cruisers left open to competition within very narrow bounds, the factors of speed, armor, and armament.

IN the previous competitions, designers had learned the great advantage of increased displacement and heavy caliber guns, so most naval constructors went at once to the 10,000-ton, 8-inch gun cruiser, with slight variations in speed and protection, depending upon the ideas of the line officers, the skill of the naval constructors, the efficiency of the establishments furnishing the materials going into the construction, and the available appropriations. It is significant that competition in design was just as sharp as before, except that it was concentrated in certain types, and confined to prescribed displacements.

The art of naval construction had practically reached a parity in the leading naval countries before the Washington Conference suggested a combat parity and ratios instead of unlimited competition in design; and there is small difference in the quality of the shipbuilding materials available in first class countries, so that it is not surprising that the 8-inch gun treaty cruisers of the five leading nations have approximately the same characteristics. This is shown by the similarity in the 8-inch gun treaty

	U. S.	Gt. Britain	Japan	France	Italy	Germany
	North-ampton	*London*	*Haguro*	*Duquesne*	*Trento*	*Ersatz Preussen*
	1930	1929	1929	1929	1929	1929
Displacement (tons) (fully equipped, without fuel or feed water)	10,000	10,000	10,000	10,000	10,000	10,000
Dimensions (feet)						
Length (over all)	600	633	630	626½	640	604
Beam	67	66	57	63	67½	66
Draft	19½	17(std) 20 normal	16½	20½	19	16
Ratio: (length: beam)	8.96	9.74	11.05	9.94	9.48	9.15
Armament:						
Guns—						
Main Battery	9 8-inch 3 triple turrets	8 8-inch 4 twin turrets	10 8-inch 2 triple, 2 twin turrets	8 8-inch 4 twin turrets	8 8-inch 4 twin turrets	6 11-inch 2 triple turrets
Secondary Battery	4 5-inch Anti-aircraft	4 4-inch Anti-aircraft	4 4.7-inch Anti-aircraft	8 3-inch Anti-aircraft	16 4-inch Anti-aircraft	
Torpedo Tubes	6 2-triple training	8 2-quadruple training	12 6-twin	6 2-triple training	8 4-twin fixed	
Airplanes	4	1	4	2	2 or 3	
Catapults	2	1	2	1	1	
Propulsion:						
Speed	32.7 stabilized	32.25 stabilized	33 stabilized	35–36	35	26
Machinery	Geared turbines	Geared turbines	Geared turbines	Geared turbines	Geared turbines	Diesel engines
Horsepower	107,000	96,000	130,000	120,000	150,000	50,000 (shaft)
Boilers	8, oil	8, oil, Yarrow	12, oil	8, oil	12, oil	
Radius of Action	10,000 at 15 knots	11,000 at 12.5 (probable)	14,000 at 14/15 knots	5000 at 15 knots	?	10,000 at 20 knots
Complement:						
Officers	45	40	?	30	43	?
Men	620	650	?	592	650	?

TABLE A

cruisers of the five nations in the accompanying Table A, in which for convenience of further comparison, is also included the German battleship *Ersatz Preussen*, which is limited by the Versailles Treaty to 10,000 tons displacement but the 11-inch guns the Germans used came as a surprise.

Table A indicates that the designers of Great Britain, the United States, and Japan have practically stabilized the speed at 32.5 knots and battery, while France and Italy are building 35-knot cruisers. They all burn oil and use geared turbines except Germany, who depends upon the Diesel internal combustion engine. This table again shows the price paid for the last few knots speed in cruisers; thus the *Ersatz Preussen* carries 11-inch guns, is comparatively heavily armored, and can make 26 knots, only 6½ knots less than the typical treaty cruiser with 8-inch guns and comparatively unarmored. There is a striking parallel in the relationship between the *Ersatz Preussen* and the Queen Elizabeth class of fast battleships, and the treaty cruisers and the Tiger class of battle cruisers.

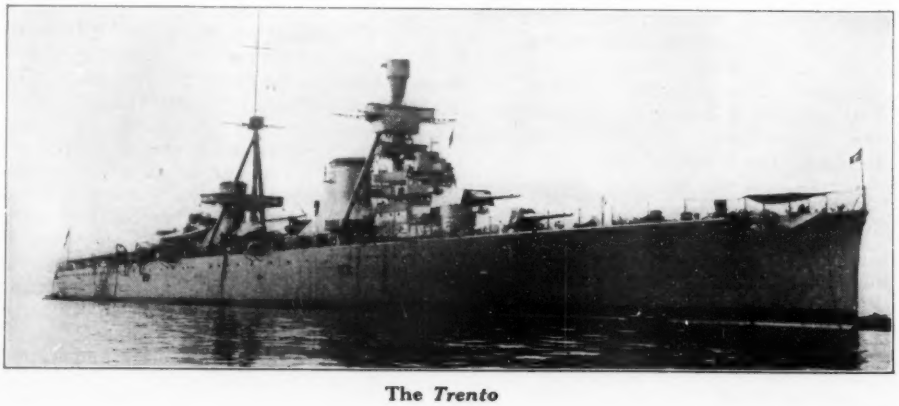
Mahan's test of a ship was: Is she well designed to accomplish her war tasks? This is a principle easier to enunciate than to apply, for its application implies the ability to determine with a fair amount of accuracy the future adversary and the nature the war will take.

At the present time, under the principle of parity, Great Britain and the United States are confronted with the problem of finding parity in cruiser strength when Great Britain believes she needs more 6-inch gun cruisers and the General Board of the Navy believes we need more 8-inch gun cruisers. Both countries trade in all parts of the world; the volume of their foreign trade over a period of five years is approximately the same; while Great Britain has more widely-spread dependencies, they are more strongly linked up by her numerous bases, whereas our water communications, even between our east and west coasts, pass directly in front of numerous foreign countries, so, generally speaking, it can be said that the naval burdens of the two countries in time of war will be approximately equal.

THE vital interests of Japan are much more closely concentrated than either American or British. She is an insular empire with adjacent continental possessions, very similar to England with French possessions under the Plantagenets. In addition to her navy she possesses the second or third largest army in the world. Accordingly, her naval ratio at Washington was made 5 to 3, and in return we agreed to cease fortifying our Far Eastern possessions. At London, substantial concessions were made to Japan, in cruisers and destroyers, and parity was given her in submarines. Members of the General Board have pointed out the additional handicaps the abandonment of the 5:3 ratio with Japan will impose upon our Navy in the event of war in the Pacific.

Naval competitions are certainly expensive and they may become provocative; limitations of naval armament will reduce somewhat the expense and if carefully done, need not jeopardize the legitimate interests of any state. But it should be recognized that *navies are symptoms of the probability of wars*, not their primary causes.

The task confronting world statesmen today should be to obtain a friendly accord between the nations of the world. Until they accomplish this preliminary essential, conferences on the limitations of armaments will continue to disappoint the fine hopes of Americans who have been led to believe that the scrapping of a few warships will banish self-interest from the peoples and ambitious policies from the rulers of the world.



The *Trento*

A Home Made Microscope for the Amateur

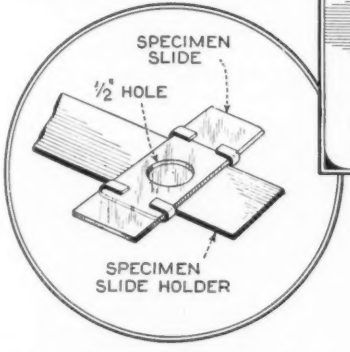
By LEON J. ISRAELOVITCH

Associate Editor Science and Engineering, *Leningrad*

A MICROSCOPE magnifying from 25 to 300 diameters may easily be constructed in the home workshop, with practically no expense. Only the simplest and most ordinary tools are required.

This may sound too good to be true, yet it is a fact. The reason is that small drops of water, which cost nothing, are used instead of expensive powerful glass lenses. A cylindrical diaphragm is also employed, doing away with blurring of the image and confusing rainbow fringes. The image thus produced is needle-sharp and absolutely free from objectionable coloring.

The upright at the right supports the lens turret. This is a thin brass or tin disk mounted with a screw and a washer. About half way from center to edge, a series of holes is drilled as neatly as possible and at equal distances from the center. The larger holes may be countersunk with a coarse needle, while the smaller ones are best left in their original condition. Burrs may be removed with very fine sandpaper. Extremely small holes are made as follows: Use the smallest drill you have and stop drilling when the tool is almost through —when a little "pimple" appears on the other side. Remove the drill, pierce the "pimple" with a fine needle and even up the edges with sandpaper.

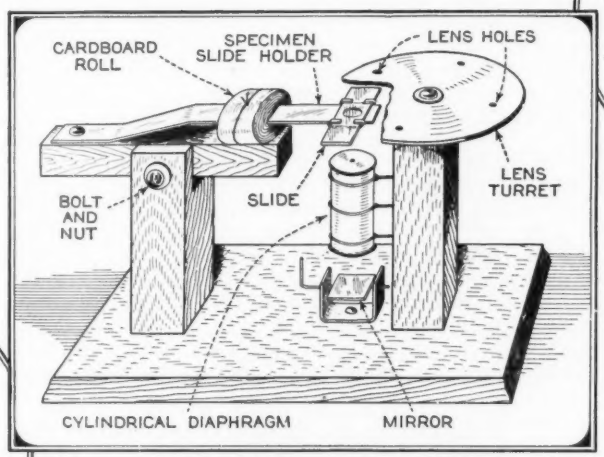


The wonder-working cylindrical diaphragm is held in place under the lens turret with three wire supporters. It is merely a small metal or cardboard tube closed on both ends with black cardboard disks and India-inked on the inside. A small hole is made in the bottom disk, while the top one or lid is pierced in the center with a fine needle heated to red heat in a flame, so it will not leave any burr.

A special holder for slips of glass upon which objects to be examined are mounted, is fashioned from a strip of thick tin. Its business end is shown in the left-hand drawing. The other end is securely nailed to the square beam. The holder is slightly bent in the middle, to accommodate a small roll of cardboard secured with glue or a thread and wound loosely enough to slide back and forth easily.

The square beam is drilled exactly in the middle and is held by a bolt and a nut, in a fork sawed out of the thick upright at the left. Washers should be inserted both inside and out, and the nut should be adjusted so that the beam tips readily and smoothly when a slight pressure is applied to the opposite end.

The U-like support of the mirror is fashioned from a single strip of tin and is screwed to the baseboard in the center to enable the microscopist to work comfortably, no matter from which direction the light falls. Liquid glue is used to attach the mirror to its looped-wire support.

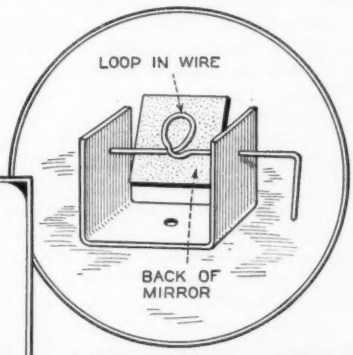


The unessential details may be modified to suit the materials available. The cylindrical diaphragm is adjusted simply by bending its supporting wires

No dimensions are given on the drawing, for the very excellent reason that they are of absolutely no importance. There is only one thing to watch for, when assembling the device. The fine pencil of light streaming up from the diaphragm should go squarely through the lens holes in the disk.

There is nothing difficult in the use of the water microscope. Decide which enlargement you need and choose a hole in the lens turret accordingly. The smaller the hole, the more powerful the lens. Rub the hole with your fingers, coating its sides with a thin film of grease, to prevent water from spreading. Dip a sharpened match into clear water and apply the point to the hole. Water retained on the match will flow down and form a nice round drop. Turn the lens turret until light from the diaphragm shows through. Work the mirror about to obtain the best lighting. When high powers are used, say 250 diameters, the source of light must be a strong one, preferably the sun or a powerful electric lamp.

Now insert the specimen slide in the



holder, and focus roughly by tipping the horizontal beam. Fine focusing is done by sliding the cardboard roll. Keep the eye as near the water as possible.

If you prefer, glycerine may be used for lenses instead of water. Glycerine does not evaporate and you will not have to re-focus every little while, as with water. Perhaps you may even care to have a microscope with absolutely rigid lenses. Canada balsam, which may be obtained at any optician's, will harden in a week or so, if it is run into the lens holes and the microscope left standing in a warm dry place.

¶ Editor's note: *William Waldeyer, a San Francisco reader of this journal, has made an interesting suggestion. "Let the mechanically inclined amateur expend, say, eight dollars for a 10x objective, mount it in a stand of his own design, and add a 5x or 10x Huygenian eyepiece, also a small lens of short focal length for a condenser. Just as in amateur telescope making a little study will be necessary, but the first qualification for a real hobby is that something must be left to the ingenuity of the amateur." For the study, Gage, "The Microscope" is recommended. No blueprints or instructions are available.*

Work and Fatigue

Industrial Fatigue Is Passing Out of Style

By DONALD A. LAIRD, Ph.D., Sc.D.
Director, Colgate Psychological Laboratory

MEN of science visiting an exhibit arranged by the Genetics Department of the Carnegie Institution, saw a specially developed race of tireless mice which danced all day long. This was a product of careful breeding. Sir Arthur Keith and Ales Hrdlicka, well-known anthropologists of England and America, see evidence that a new type of man is emerging from the biological melting pot in America. Greater resistance to ordinary fatigue may be one of the characteristics of this new biological development in the human race, but none of us, obviously, shall live long enough to see this changed specimen. And it will not help to make us at present more resistant to fatigue.

Fatigue will doubtless be removed pretty thoroughly from the world many decades before the new biological man has emerged. In fact, one who has been keeping in close touch with the progress of fatigue elimination in industry for the last ten years knows definitely that a great deal of fatigue has already been eliminated.

IT is not the invention of labor-saving machinery that is doing most to eliminate fatigue. Such machinery may save the labor of three men, but add to the fatigue of the two men who operate it. The noise and jar and "high speed" attention the new machine demands is often more fatiguing than the brute labor that it is replacing. An invention can be labor saving but fatigue increasing.

Realizing this truism, some years ago the Society of Industrial Engineers organized a special Committee on the Elimination of Unnecessary Fatigue. This committee, to which I have the honor of belonging, serves to stimulate and co-ordinate the work on the conquest of fatigue in America. It has brought together mechanical engineers, physicists, physiologists, and psychologists on a common battle-ground for applying their sciences. In England we find a more formidable and official organization for battling fatigue, in the form of the Industrial Fatigue Research Board, which is a part of His Majesty's Governmental agencies. This board keeps a large group of investigators active in the textile, metal, wood-working, and other industries, searching out new facts about fatigue and new ways of eliminating it.

There are four general sources of fatigue which, fortunately, are being attacked by modern Saint Georges. The most treacherous and insidious source is poor emotional adjustment of the individual. One who is of necessity engaged in work which he does not like, or for which he is otherwise poorly adapted, is especially likely to experience a vague but pernicious fatigue. The rapid growth of vocational guidance in the schools, and the development of psychological tests for determining fairly accurately what work one can do best, are powerful forces for eliminating much emotionally generated fatigue. Monotony is another cause of emotional fatigue. We know that there is no such thing as intrinsically monotonous work; work which is monotonous to one person is fascinatingly interesting to another, but it is highly important that each individual work at a job which is not monotonous to him.

Fatigue of an emotional origin also arises from poor supervision of workers. The roughness of the foreman of the old school caused much fatigue. Today foremen and other supervisors are being given special training in how to handle people. This foremanship training, which is on a state-wide basis in states such as New York, is already eliminating much fatigue which has been caused by reprimanding and ill-chosen supervision of the kind not based on a good comprehension of the nature of human nature.

HUNDREDS of thousands of persons are suffering from fatigue of emotional origin, which however, has no relation to their daily tasks. These are persons with a poor emotional adjustment to life in general. They are persons who "enjoy being tired," just as about the same number "enjoy poor health." These thousands who awaken feeling tired after eight to ten hours of sleep need a general probing of their inner emotional lives. Psychiatrists and mental specialists are undertaking this on a grand scale throughout the country, largely as a result of the work of the National Committee for Mental Hygiene. Specialists have been trained for this work, and wholesale clinics

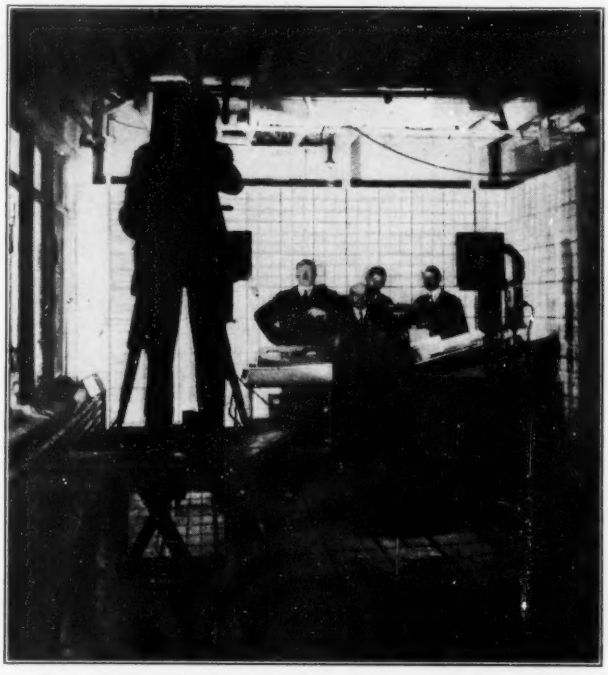
Courtesy of Harrington and King (Chicago)

A ceiling designed to absorb noise; adequate artificial lighting; restful wall colors; and venetian shades, free this office from environmental fatigue

have been established in a dozen large cities. Some larger firms have their own specialists who are engaged full time in guiding their workers to emotional readjustments which have not been caused by their work, but which are nevertheless a fatigue handicap.

The following typical case of this type of fatigue has been reported by Dr. V. V. Anderson who is engaged in this work with R. H. Macy and Company in New York. This case may be taken as illustrative not only of the pernicious hidden emotional causes of fatigue, but also of the highly socialized "long view" many employers are now taking of the problems of fatigue elimination.

Mary T. was a successful sales clerk, 35 years old. For half a dozen years she had been complaining of being tired and needing a rest. From time to time she had been given short leave from work with pay, and finally took six months with pay. The family doctor reported that she "must have a complete rest."



Studying less fatiguing methods of work by means of the moving-picture camera set up in a manufactory

UPON Mary's return to work the store psychiatrist gave her state of chronic fatigue skilled study and found that "she acts very tired, seems exhausted, sits down a lot, leans against the counter, and seems to be a changed girl from what she used to be." Emotional causes for her chronic fatigued state were readily found. She has made but few friends, never goes out, and her only pleasures seem to center in the home of her father and mother, although her father complains a great deal about her not getting married. She is very jealous of her married sister and frequently has trouble at home with her father. When these unpleasant situations develop she indulges in a temper tantrum or appears to become ill, and thus obtains great sympathy from her mother and sister. Her "tired feelings" are another way of gaining sympathy and attention.

The psychiatrist explained her situation to her frankly, planned a scheme of emotional re-education for her, including social and recreational activities to keep her away from home, and arranged for her to have half-time employment. She needed to understand how she had been seeking pity and sympathy through appearing tired, whereas healthy emotions demanded the equivalent outlet through accomplishments and service to others.

Her entire emotional attitude toward herself, her job, her home, and life in general was altered. Her mental health improved vastly and her chronic fatigue disappeared. She is now working full time and topping her department.

According to Dr. Anderson such cases are very common, and develop easily in almost anyone. They are neither normal nor abnormal, but in the broad borderline zone.

A second important general cause of fatigue is the physical condition of the individual. The phenomenal strides now being made in general hygiene and public medicine are accomplishing near-wonders, an example being the elimination of much of the pathological fatigue caused formerly by the hook-worm in vast areas in the southern states. The growing use of routine medical inspections of employes by company physicians is also accomplishing a great deal toward avoiding fatigue which is caused by some organic trouble rather than by the work itself. Some concerns, like the Dennison Manufacturing Company, have their executives undergo complete medical examinations semi-annually.

The activity of the ductless, or endocrine, glands appears to have a profound relationship to one's fatigue, although there is no definite single glandular mixture which is a cure-all for tiredness. This is a field both of great promise and great obscurity.

One of the most interesting aspects of the relation between bodily conditions and fatigue is the chemistry of the fatigue changes brought about by work itself. As physical work is done glycogen is consumed by the muscles, with the production of lactic acid and carbon dioxide as residual by-products. The carbon dioxide liberated is gradually breathed off, although in the case of excessively severe work some excess carbon dioxide may be stored in the adjacent tissues to be breathed away during less active moments. Lactic acid appears to be the definite cause, however, of actual fatigue caused by work. In almost every variety of steady work the lactic acid is produced more rapidly than it can be removed, bringing about a definitely toxic condition. This condition may spread to remote parts of the body. Heavy work with the right arm, for example, can readily produce an excess of lactic acid which spreads to the left arm. Working with one arm may thus tire the other arm; we also can recover from some of the fatigue of the right arm by the action of blood oxygen on the lactic acid in the left arm.

No chemical has yet been discovered which will offset these accumulations in the working body. During the World War, however, German troops were given sodium biophosphate before long marches, on the theory that this would offset the lactic acid formations.

IT is a fact that soldiers given this substance were usually fatigue-resistant, but more recent experiments have shown that the biophosphates did not produce this result by causing the lactic acid to disappear. It does help eliminate fatigue, but just how it works still is a question.

Since the body itself will attempt valiantly to remove the lactid acid, much excess fatigue has been avoided in industry by the introduction of rest periods so that the chemical factories of the body can remove much of the acid before there is such an excess that there will be the possibility of a serious fatigued state. Girls folding handkerchiefs, for instance, are least fatigued when they fold for five minutes and rest one minute. In heavier work, such as carrying pigs of iron weighing 92 pounds each, fatigue is least when each 12 minutes of work is followed by three minutes of rest. It is a paradox of mankind that by resting at the proper times they can do more work with less fatigue.

Some day a substance may be discovered which will take care of the lactic acid accumulation and take the place of rest periods. At present industry knows no such substance, hence each month sees a few thousand

more workers being forced by their employers to rest during working hours.

Another paradox which is a result of the accumulation of lactic acid is that the longer workers are at work the less they accomplish. Workers who have been engaged in work eight hours a day, for example, when put on overtime which requires ten hours work a day, will do less after two weeks in the ten hours than they formerly did in the eight hours. The extra two hours work is doubly pernicious in adding to the total production of the acid, and subtracting from the rest hours during which the accummulation can be overcome.

With the shorter work week, as well as the shorter work day, large amounts of human fatigue will be eliminated—provided the worker knows how to use the added leisure time so that there will be no further accumulation of fatigue.

The third general direction from which fatigue is being attacked is by adjusting the environment so that less indirect fatigue is caused. The poorly lighted factory and home of a decade or two ago were the cause of much indirect fatigue—not only eye fatigue, but muscular fatigue due to the increased tension of the muscles in giving attention. Muscular tension is a form of work which consumes glycogen and produces carbon dioxide and lactic acid, even though no productive work is accomplished. With the invention of the incandescent bulb half a century ago Edison paved the way for the elimination of much unnecessary and indirect fatigue.

IN the past decade a great deal has been accomplished by applying scientific knowledge concerning the relationship between temperature and fatigue. When the temperature goes above 68 degrees, Fahrenheit, fatigue is abnormally increased, unless the cooling power of the air is increased by being set in motion. Thermostats and chemical refrigeration are now being widely used, not merely in those industries which are intrinsically heat-producing, but in offices as well.

Within the past year or two another cause of indirect fatigue has been stalked out into the open—noise. I am naturally proud of the part the Colgate psychological laboratory has had in discovering minimum allowable noise analogous to the optimum temperature of 68 degrees, Fahrenheit. Scarcely a new office or factory is designed now without noise control being given thoughtful consideration, and many old work places are being remodeled so that they approach the minimum allowable noise of 35 decibel units.

The three general causes of fatigue—poor emotional adjustment, bodily condition, and environmental forces—have been discovered and worked out, largely by men of science outside of industry. The fourth general cause has been attacked largely from within industry itself.

This fourth general cause is fatiguing methods of work. Research on this source of loss received its impetus in the United States three decades ago. For the following 20 years the investigation was kept up, largely to gain increased output rather than directly to reduce fatigue. The last decade however, has witnessed a shift in the approach, because it has been demonstrated thoroughly that the greatest output is achieved when the methods of working are least fatiguing. So, in place of trying directly to reach greater output per worker, the approach now is to reduce all possible fatigue in methods of working. Thus the output will take care of itself better than it would if one tried directly to improve the output factor alone. The aim should be to make the work as easy as possible; very greatly in contrast to the primary aim of the "efficiency expert" with his pockets full of colored pencils, who, thank goodness, is going out of fashion along with fatigue. I believe in general that England is more awake to this changed approach than is America.

Time exposure record of movements of the hands of a worker. When given expert study this picture will reveal waste effort

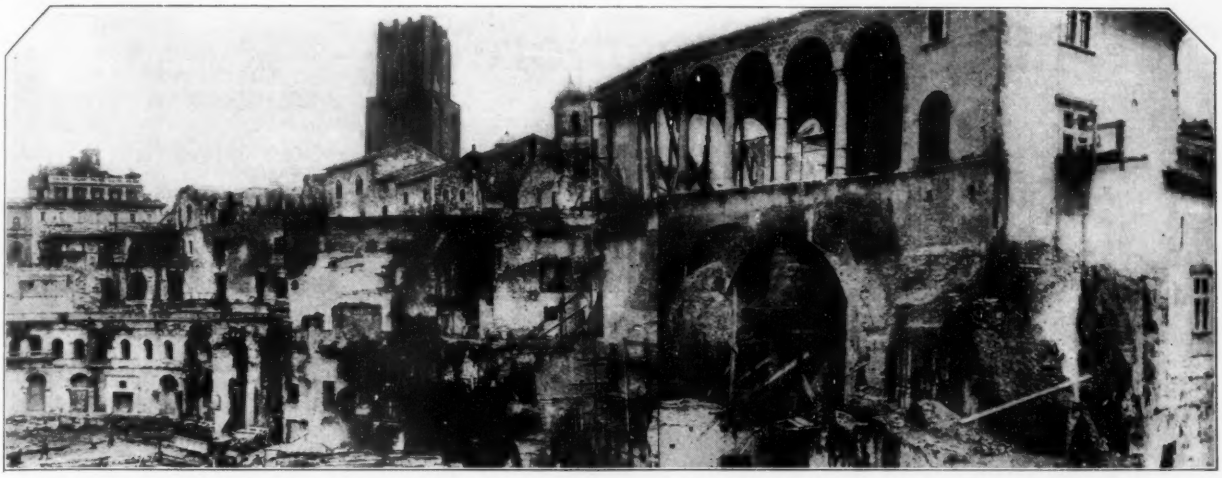
So much of the work that has been done to make working intrinsically easier is so simple and so obvious that it reflects little credit to the human mind that this has not been done years ago. Take, for example, the small metal stand on which hot irons are placed in the laundry. These metal stands are necessary to keep the cloth covering of the ironing board from being scorched while the goods to be ironed is being smoothed out. It has not been unusual for these metal stands to be six inches in height. Lifting a five-pound iron to this height an average of 60 times an hour constitutes 150 foot-pounds of work, and since the human body has an efficiency only of about 20 percent, this means the consumption of bodily energy equivalent to 750 foot-pounds. Today iron racks scarcely an inch high and sloping gently toward the point are in use, so that the iron does not even have to be lifted but is simply slid on to the rack.

In tin-plate and sheet-steel manufacture human effort is being diminished, more perhaps in American than in English mills. In feeding the heavy bars or plates to the rollers which flatten them gradually into sheet form English workers have to lift them from two to three feet. The rolls are conventionally several inches lower in American mills, and thousands of horsepower of human energy are saved daily through this difference of a few inches. An inclined runway with freely idling rollers is now being adopted to bring the sheets or bars all the way to the powered rollers by sliding the plate along rather than lifting it. Thus more fatigue and sore arms are eliminated. Similar application has been made in hand-stoked furnaces, where coal-hole doors are no longer four feet above the floor level.

LIFTING, stretching, bending, stooping, sitting all day, standing all day, produce fatigue rather than effective work, and they are being eliminated with amazing rapidity in modern industry. Special departments are being established in large work-places to train new workers how to work most effectively with least waste fatigue. All these pay both financial and human dividends.

Intensive experimentation since this article was first written is now indicating definitely that a diet rich in carbohydrates and especially quick-energy sugar of the common table variety will lessen the fatigue loss which ordinarily comes from the depletion of glycogen and the accumulation of lactic acid. These experiments at Colgate University and at Temple University have shown that less fatigue is experienced when this preparation is made for exertion.

One does not have to be a carping critic to notice that the general pace of life is getting more severe during man's leisure, but one does not have to be a blind optimist to discover that the work of the world is rapidly becoming less fatiguing. Whether the diminished human strain incidental to the work of the world will compensate for the increased human strain during man's idle moments, is a question I can not answer, but is a question of grave significance.



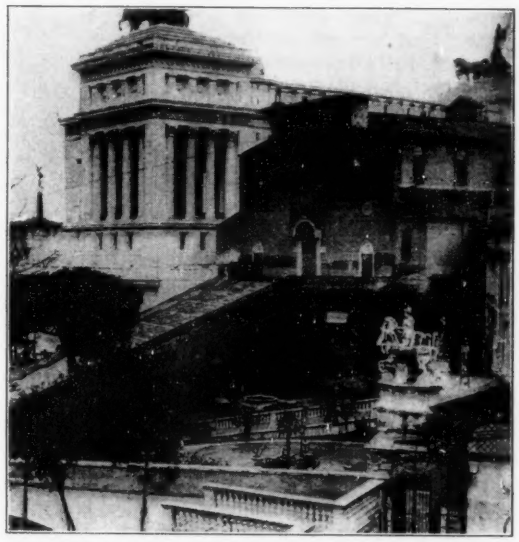
The Rome of the Caesars reappears in the modern Rome of Mussolini: The Fora of Augustus and Trajan

Rome's Slums Reveal Imperial Ruins

WHATEVER the Fascist government may have done or left undone, one great accomplishment stands to the credit of the great leader "Il Duce." This is the carrying on of excavations on an unprecedented scale. Excavation in a crowded city like Rome under post-war conditions presents grave problems. Where the density of population is very great, the slums can not be destroyed until the people are housed. When the ruins are uncovered they are made available to the scholars of the world, and wherever possible they are given a landscape setting.

In Italy cultural matters are receiving their due. While other countries have allowed important buildings to be sacrificed for utilitarian purposes, Italy has always looked askance at the tempter and resisted, which is hard when it is necessary to contend with national poverty.

Our illustrations show how the beauty of the ancient structures has been revealed after demolition of ugly modern buildings. The Fora of Augustus and Trajan, which for centuries have been covered by later buildings, are now emerging in a remarkable state of preservation. The tower shown in the photograph above is the so-called "Tower of Nero" from which he observed the burning of Rome. Unfortunately for the story it was built in 1200 A.D. Adjacent, a great covered market with 150 shops in the Oriental style has been discovered. The "Theater of Marcellus" has been laid bare down to the foundations. The temples of Vesta and the Vestal Virgins have been freed from buildings.



A new vista opened in modern Rome, displaying the Victor Emmanuel monument towering above the Aracoeli church after demolitions

The Temples of Vesta and the Vestal Virgins now entirely cleared of old obstructions of later buildings

The Theater of Marcellus reappearing after being concealed for centuries by squalid structures now removed

The Imperious Sycamore

By WILLIAM ALPHONSO MURRILL

"Clear are the depths where the eddies play,
And the dimples deepen and hurl away;
And the plane tree's speckled arms o'ershoot
The swifter current that mines its root."

Bryant

WHO has not at some time rested serenely in the shade of a big sycamore tree with scaly, white trunk and wide-spreading branches? I well remember one of these giant trees that stood alone in a fertile meadow, with a cool spring nearby and cultivated fields all about it. At noon the men would come with their horses and wagons—there was room for all and to spare—and eat their dinners while the horses finished their oats or corn and chewed contentedly at wisps of grass.

At wheat harvest and threshing time, the women-folk would meet the men at the tree and spread good things from big baskets on tablecloths laid upon the grass. Appetites sharpened by hard work would take on a razor edge at the sight, and soon a few of the older men would be taking little cat-naps while their stomachs wrestled with unusual responbilities.

THEN the "boss" would get up and squint at the sun, or peep at his big silver watch, and say, "Well, men, I reckon we've rested long enough; let's get busy."

With this scene in mind, it is not difficult for me to imagine the religious ceremonies held beneath the oriental sycamore on the plains of Persia, when splendid rugs were spread upon the ground, the roots of the tree wet with libations of fine wine, and the branches bedecked with jewels and gold. It is said that Xerxes halted his army for days just to behold a single tree of this species, which was so imperious and shapely that he had its form stamped upon a medal in order to have it before him the rest of his life.

The Greeks also venerated this noble tree and planted it in groves and about their dwellings. The botanical name *Platanus* is derived from the classic Greek name, which refers to the broad leaves. In Europe, it is known as the plane tree, while the name sycamore is always applied to a maple with leaves resembling those of the plane. In still earlier times, the name sycamore was applied to a fig tree, the wood of which was used for mummy cases. The tree which Zaccheus climbed for a better view was Pharaoh's fig, *Ficus Sykomorus*, a native of northeastern Africa. Fig, maple, plane—all sycamore; but in America it is still sycamore, in spite of the wise ones.

The American sycamore, or western plane, is the largest hardwood tree in North America, sometimes reaching a height of 170 feet and a trunk diameter of 11 feet. A specimen at Sunderland, Massachusetts, measured 22 feet in circumference and over 100 feet in height when it was three hundred years old.

A sycamore of the Wyandotte Indians, at Sandusky, Ohio, was once the largest tree between the Alleghanies and the Rockies, four acres of ground being shaded by its immense top. After the Indians ceased their pow-wows, it became a favorite place for picnics, and then a group of young men made it a Sunday rendezvous for drinking and card-playing. The owner appealed to them to quit the place but they refused, so he burned the tree. Unfortunately, its age was never computed, but its trunk was fully 11 feet or more in diameter.

Specimens of the oriental plane have been known to have lived 4000 years. On the Greek island of Cos there is one so old and ponderous that its branches had to be supported with marble columns. It stands in a public square

In low, rich land, the sycamore thrives and makes a beautiful shade tree such as the one shown in the meadow at the left. Below at left are shown bark, fruit, and leaves of the western plane or American sycamore. Below at right, of the London plane tree

and is held in great veneration by the inhabitants.

Our American sycamore tree occurs wild from Ontario to Florida and westward to Minnesota and Texas, preferring open meadow land or low woods. The bark is very characteristic. On the young trunk it is smooth and greenish gray. The outer bark flakes off annually in large patches, exposing the white under bark. Near the base of old trees, the bark becomes thick, deeply furrowed, and dark brown. The trunk appears at times like an old warrior covered with battle scars.

The large, simple, somewhat star-shaped leaves are sometimes seven inches broad; and the fruit is a ball an inch in diameter hanging by a slender stem during the winter and breaking up in the spring, when the small seeds are widely scattered by the wind.

At right: **peeling bark of the American sycamore. The bark that is exposed is a creamy white**

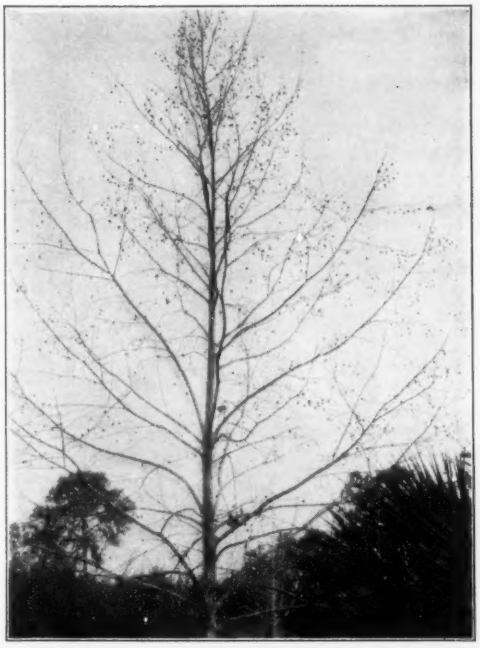
THE wood is rather strong but decays rapidly in contact with the ground. It is used for butchers' blocks, tobacco boxes, furniture, interior finish, crates, tools, and rollers. The reddish-brown color is attractive, but the logs are "mighty hard to split."

The plane trees form a family all by themselves with only eight species, natives of the north temperate zone. We have one native species in the eastern United States while there are two others in the west and three in Mexico.

The oriental plane was brought to Europe by the Romans from its home in southern Asia and has been abundantly planted as a shade tree in cities. A hybrid between it and our western plane, known as the London plane, is the most abundant and thrifty tree on the London streets and is very popular in this country. Our tree was introduced into England early in the 1600's and at one time the French were quite fond of it.

The sycamores, or plane trees, are all more valuable for shade and ornament than for lumber. They rank next to the oaks as street-trees, and are preferred by many. With the annual scaling of the bark, the tree rids itself of the smoke and dust of cities. The branches may be cut back as often and as freely as desired without permanent injury to the tree. The sycamore blight disfigures our tree in the spring, as well as the London plane, but the leaves come out again in time to keep off the hot summer sun.

In Paris, at least one third of all the street trees are planes. With plenty of good soil and water, these trees keep vigorous in spite of the severe conditions of city life. They are large enough for wide avenues, and they can be cut to fit the narrow streets on which they are often planted.



The American sycamore in winter presents an appearance of sleekness and fruitfulnes

For the benefit of those who find it difficult to distinguish between our native western plane and the London plane—which is still called the oriental plane by most of our nurserymen—I would say that the two trees differ in their bark, leaves, and fruits, as well as in their general form; but a glance at the bark and fruits of any doubtful tree will at once decide the question. When the London plane sheds its bark, the patches beneath are pale greenish, instead of white as in our species. The fruits of the western plane are usually borne singly, while those of the London plane are in clusters of two to four, with the balls often arranged one above another.

THE long, tapering single seeds are tightly compacted within these balls, radiating out from a hard core. The minute flowers are borne in pendulous heads containing either male or female flowers.

The leaves of the oriental plane are five-lobed, hairless, of a bright green color, and are arranged alternately on the twigs. The leaves of the London plane are usually three-lobed. The western plane—the American sycamore which is also sometimes called the buttonwood—has leaves that are more leathery and less deeply lobed than the oriental plane. Other common varieties under cultivation are the maple-leaved plane and the *variegata*, which has variegated foliage.

Either the American sycamore or the London plane makes a sturdy street tree. Often they are trimmed and shaped somewhat in the manner of hedges

Typical of South Carolina's produce farms. Snap beans on a farm near Charleston

Vegetables That Defeat Goiter

By M. BISHOP ALEXANDER

"IODINE." This word stands out prominently on the labels attached to shipments of fresh and canned vegetables from the state of South Carolina to all parts of the nation. We are frankly puzzled. What does it mean? Why iodine? The answer is found in the wording on the label. We scan it closely and find thereon the statement that:

"South Carolina fruits, vegetables, and milk naturally contain sufficient iodine to provide for the requirements of nutrition."

The explanation of the answer and its importance is readily seen in the authoritative statement from scientific and medical sources that all animals require certain amounts of iodine to prevent goiter. The importance of the discovery and announcement that South Carolina grown products contain iodine, which in proper quantities is a goiter preventative and cure, is further indicated by the following official statement:

"THERE are 30 million persons in the United States who have an iodine deficiency and two thirds of the states are in the iodine deficiency area."

Dr. Weston, a prominent physician and baby specialist of Columbia, is credited with discovering and calling attention to the mineral value of South Carolina grown products. Observing in his practice that goiter was exceedingly rare in South Carolina and being familiar with the work of American and European investigators on the relationship of iodine to this malady, he conceived the idea early in 1923 that the foods grown and consumed in South Carolina must be responsible for the very low percentage of goiter in that state. He discussed this idea with several of his friends and finally prevailed on the General Assembly of the state to provide for a commission to study the mineral elements in foods grown or produced in the state. Thus came into being the South Carolina Food Research Commission.

GOITER is an abnormal condition of the thyroid gland caused by iodine deficiency. And since the substances secreted by the thyroid govern the growth of all cells, promote metabolism, and perform many other useful functions in the body, it is vitally important to maintain this gland in healthy condition.

In an article in our April, 1926, issue, Dr. J. W. Turrentine pointed out that America is a goitrous nation and urged the use in foods of marine algae as a preventative and cure. The present article is, therefore, a fitting follow-up, and especially since it indicates a more palatable food cure.—*The Editor.*

This commission consists of Dr. D. M. Douglas, President of the University of South Carolina, Dr. E. W. Sikes, President of Clemson College, Dr. Robert Wilson, Dean of the Medical College of the State of South Carolina, Dr. J. A. Hayne, Secretary of the State Board of Health, and two others: Dr. Weston, who acts as chairman, and Dr. R. R. Walker, Secretary, appointed by the Governor.

The South Carolina Food Research Commission established its laboratory in affiliation with the State Medical College at Charleston and under direction of Dr. Roe E. Remington, who was called from the University of Minnesota to take charge of this important work.

During 1928 and 1929, Dr. Remington examined in the laboratory at Charleston hundreds upon hundreds of samples of vegetables grown in all sections of South Carolina, for their iodine content. He found the amounts of iodine in them enormously greater than those reported by other laboratory workers in vegetables from northern, western, and, in fact, any other states.

THIS discovery in conjunction with the goiter survey made by the Field Force of the South Carolina State Board of Health, in which it was found that goiter was practically non-existent in the state, led to the definite conclusion that goiter will not occur if foods that naturally contain a sufficient amount of iodine are regularly eaten.

The results of the analyses of South Carolina foods for iodine content were broadly summarized by Dr. Mazyck P. Ravenel, in the *American Journal of*

Public Health, September, 1929, issue, as follows:

"While similar data (analyses) for the entire country are not available for comparison, it can be said that the vegetables grown in South Carolina contain from 20 to 30 times as much iodine as those produced in . . . . and . . . [two great vegetable-growing states—*The Editor.*] * * * * * It has already been pointed out that the vegetables which are richest in iodine are also richest in vitamins and iron."

The amount of iodine necessary in the daily ration in order to maintain iodine balance is variously estimated. The only careful experiment is that of Dr. von Fellenberg, of Switzerland, who was able to maintain iodine equilibrium over a period of four weeks in a man on a diet which contained 0.0143 milligrams per day (equivalent to 5.22 milligrams per year).

DR. REMINGTON has calculated the weight in ounces of some fresh vegetables from South Carolina which will yield this amount of iodine.

LEAFY VEGETABLES	
Cabbage, average of 8 samples	7 ounces
Lettuce, average of 9 samples	8 ounces
Spinach, average of 14 samples	7 ounces
Turnip tops, average of 5 samples	10 ounces
POTATOES	
Potatoes, average of 76 samples	11 ounces
Sweet potatoes, average of 70 samples	16 ounces
ROOTS	
Beets, average of 4 samples	24 ounces
Carrots, average of 8 samples	21 ounces
Turnips, average of 12 samples	23 ounces
Asparagus, average of 22 samples	27 ounces

On this basis, a diet containing four ounces of green vegetable, eight ounces of potatoes, and four ounces of root vegetable would yield 0.021 milligrams of iodine per day which is about 150 percent of the value set by von Fellenberg. Since this quantity can be, and frequently is, eaten at a single meal, it is felt that these vegetables are adequate for goiter prevention when eaten regularly.

"A sufficient amount of iodine in the food supply," Dr. Weston says, "is essential to the well-being of every individual, and if deficient there results

Dr. Roe E. Remington, who directs the food research at the laboratory in Charleston

enlargement of the thyroid gland in the neck, lowering of mental and physical ability, and ofttimes sterility.

"We have learned that some foods are more valuable than others in regard to their content of chemical elements. Among the best are lettuce, spinach, cabbage, carrots, beet tops, turnip tops, kale, and broccoli." He said also that "modern methods of canning do not seriously impair, if at all, the chemical elements of fruits and vegetables."

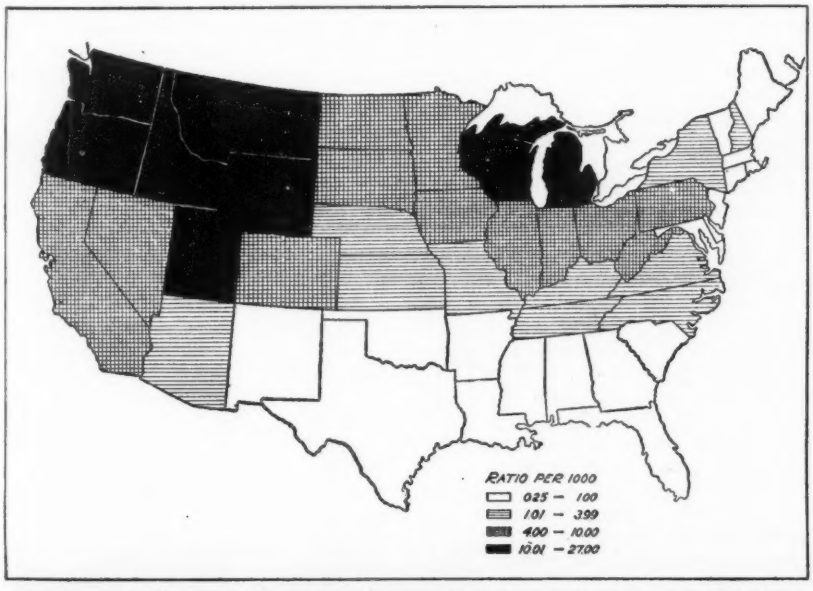
Figures compiled by the United States Public Health Service show that the goiter incidence is high and is a serious problem in large sections of California, Connecticut, Colorado, Kentucky, Illinois, Indiana, Idaho, Kansas, Louisiana, Minnesota, Michigan, Massachusetts, Missouri, Montana, Maine, New York, Oregon, Pennsylvania, Utah, Virginia, West Virginia, Washington, and Wyoming. The northwest has a high incidence.

From an historical standpoint, goiter is one of the most ancient and interesting diseases. It was a health problem in China 15 centuries before Christ, and it was then a custom among the Chinese to feed thyroid substances from animals and the ash from burnt sponges and other materials, now known to contain iodine, in the treatment of goiter.

Iodine first was discovered in 1811 by Courtois, a saltpeter manufacturer of Paris, and its first deliberate use as an element in the treatment of goiter was by Coindet, a physician of Geneva, in 1820. Thirty-two years later, Chatin directed attention to the fact that goiter was more prevalent in regions where soil and water were low in iodine content. Between 1922 and 1927, Dr. J. F. McClendon, Professor of Physiological Chemistry in the University of Minnesota, published a series of articles which were largely responsible for definitely crystallizing the relation between a deficiency of iodine in the food supply and the incidence of goiter.

THE South Carolina Food Research Laboratory was made ready in 1928 and after a number of analyses had been made it was decided to seek expert advice as to checking the equipment, methods, and laboratory results. In a conference in Chicago between Morris Fishbein, M. D., editor of the *Journal of the American Medical Association* and a Contributing Editor of the SCIENTIFIC AMERICAN, Dr. Clifford Grulee of the University of Chicago, and Dr. Weston, all agreed that, because of his international reputation and high standing among chemists, Dr. McClendon was the man for the task. Negotiations were entered into with him and later he visited the laboratory. After carefully checking the apparatus, methods of analysis, and the results, he enthusiastically stated that he believed the solution to the serious goiter problem had been found. In 1929, he spent his summer vacation in the laboratory and again freely confirmed the results obtained there.

Since the endorsement of Dr. McClendon, the reports made by the laboratory under Dr. Remington have been accepted without question by the American Medical Association and the American Chemical Society. Dr. Mazyck P. Ravenel, Chairman of the editorial committee of the *American Journal of Public Health*, has also expressed the opinion that the laboratory has "found the solution of the gravest health problem confronting the people of the United States."



Ratio of simple goiter found in men examined for service during the World War, based on 2,510,701 examinations. From U. S. Public Health reports

Inspecting hanks of artificial silk in a large American plant

Mechanical Silkworms

By GRACE LOCKHART

"WILL you walk into my parlor?" said the spider—and man walked in! Ever seeking new worlds to conquer, he carefully examined "the prettiest little parlor that ever he did spy." And then he walked out—to compete with his spider-host.

Silk is a liquid substance secreted from their food by various insects, of different families, but principally by the spider and the silkworm family. The silk of the spider family is of most exquisite quality, and is the finest spun filament produced in nature. From time to time it has been used to make fragile silken articles. But the small amount of the product and the difficulty of controlling spiders have made its commercial use in large quantities impractical.

YEARS of patient experiment followed by many practical tests resulted recently in perfection in the scientific laboratories of the American Bemberg Corporation at Elizabethton, Tennessee, of the closest approximation yet made by man to spider filament.

The diameter of spider filament measures 0.00023 of an inch, the diameter of the man-made filament 0.0004 of an inch. An ordinary newspaper sheet is nine times the thickness of a single filament of the man-made product, and in a single pound there are 4227.5 miles of filament. Out of it are being woven the filmiest of laces, the sheerest of chiffons, exquisite fabrics for modern womankind—at once beautiful and enduring.

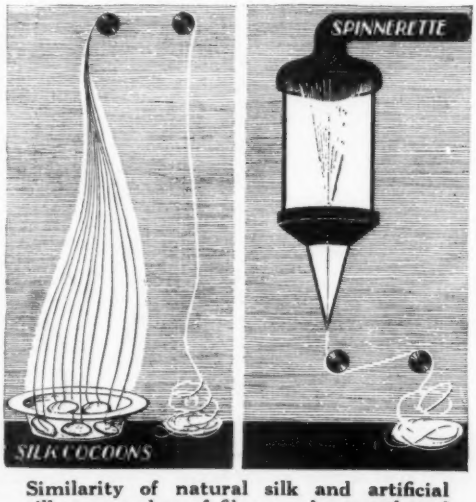
The size of yarn is designated by the term "denier," this yarn being 15 denier. The inventive mind, however, is seldom content to rest on the laurels of past achievements, and it is said that a 5-denier yarn was successfully spun in the Elizabethton laboratories to the astonishment even of the spinners themselves. It was so fine that those who watched could not see it. The hand could feel it, but the filament was invisible to the unaided eye.

THE basic raw material used in the manufacture of the yarn is cotton linters, that very unprepossessing gray fuzz that clings to the cotton seed after ginning. By a stretch-spinning cuprammonium process of manufacture, unnumbered tons of linters, formerly a waste product, are now being transformed into soft, shimmering multi-filament strands of Bemberg. So similar to silk thread, both in internal structure and external appearance is the produced yarn, that, woven into hosiery or into fabrics, experts cannot by sight or touch distinguish between the man-made fiber and the product of the silkworm.

Curiously, an order was recently received, the first of its kind recorded in history, for man-made spider webs. They were woven by hand with infinite patience in the laboratories of the American Bemberg Corporation and used for decorative purposes in "Old Algiers," first unit of a new chain of restaurants at Broadway and 102nd Street, by the well known restaurateur, William Childs. The interior reproduces an old Algerian village and in this very interesting manner modern scientific skill was called upon to heighten the illusion of antiquity by supplying artificial spider webs with which to decorate odd corners of the restaurant.

The cuprammonium process of manufacturing these ultra fine filaments was perfected after patient investigation of the interior of the silkworm and careful study of his spinning technique. The silkworm's product is made from the cellulose of mulberry leaves, the man-made fiber from cellulose of cotton linters. The dissolved cellulose of linters is drawn through tiny perforations in the mechanical "spinnerette" exactly as it is drawn through minute orifices called "spinnerettes" in the neck of the silkworm.

From the point of view of volume, however, the machine distinctly has



Similarity of natural silk and artificial silk: a number of fibers make one thread

the advantage. One silkworm during its lifetime can produce from two to six filaments of silk thread about 1000 yards in length, whereas the machine produces 112 filaments at one time and in a thread that is endless. Cuprammonium yarn produced last year throughout the world would more than reach from the earth to the moon —a mean distance of 238,857 miles.

In the chemical process by which these miles of glistening filaments are produced, the linters are washed, bleached, and then dissolved in a solution of ammonium copper oxide. After being aged, the solution is filtered and pumped to the spinning machine. As it passes through the spinnerette into a fixing bath the surplus stretch is taken out of the filaments before they unify so that they emerge in a thread of unusual strength and pliability.

DUE to the minute accuracy of the machine, it has been possible to improve upon nature's product. Microscopic cross-sections of silk threads and threads made of Bemberg show an amazing similarity of structure, with greater uniformity of filament structure in the man-made fiber. Fiber and fabric have the same appearance, the "hand," texture and bloom, the scroop and crunch, and the subdued luster of pure silk.

Besides the cuprammonium method there are three other important processes of manufacture used today for making these yarns. They are known as the viscose, cellulose acetate, and nitro-cellulose processes. The resultant fibers and fabrics woven from them differ considerably from each other in characteristics and qualities. The volume output, known generally to the public as rayon, is made by the viscose process, sometimes of wood pulp, sometimes of linters. About 85 percent of the chemical yarns manufactured in the United States are made by this process.

The United States has invested more than 120 million dollars in plants for the manufacture of synthetic yarns, while the world investment is estimated to be one and a quarter billion dollars. The total world production last year was over 468 million pounds, of which the United States, both the largest producer and the largest consumer of chemical yarns, produced more than 100 million pounds. Less than half a century old, man-made yarns have been developed and perfected until today they rank in importance with the ages-old silks, cottons, woolens, and linens.

Looking backwards, we find, in the year 1734, an ingenious Frenchman named Bon making hosiery and gloves out of spider web; not, however, with spectacular success and not, certainly, for mass consumption. A century later one George Audemars of Lausanne, Switzerland, obtained a patent for transforming dissolved nitrocellulose into filaments which he called, descriptively, "artificial silk."

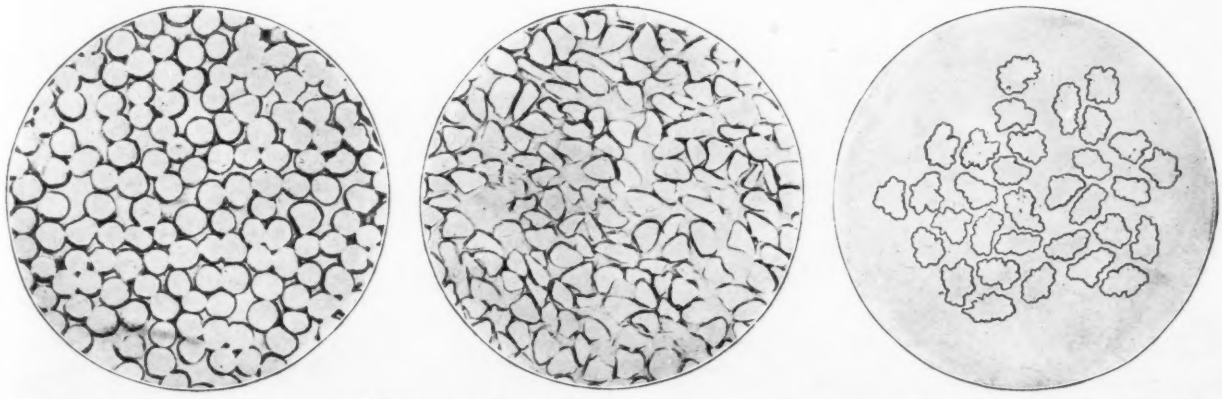
Spider web of man-made filament in the courtyard of a New York restaurant

Efforts to produce this material, however, did not assume commercial importance until 1884, when Count Hilaire de Chardonnet, called the "father of the rayon industry," perfected a practicable process for manufacture. His achievements were viewed by the public for the first time at the great Paris Exposition of 1889, and excited much interest.

COMMERCIAL production of synthetic yarn was begun in Germany, in France, and in Great Britain at the opening of the 20th Century. Plants were established in Italy in 1908, in Holland in 1912, and in the United States in 1910. During the last five years constant experiment with resultant improvement in technique and the rapid development of new uses for chemical yarns has resulted in a spectacular increase in their production. In 1927 the world production was 269,822,000 pounds. In 1929 it had increased to 467,330,000 pounds.

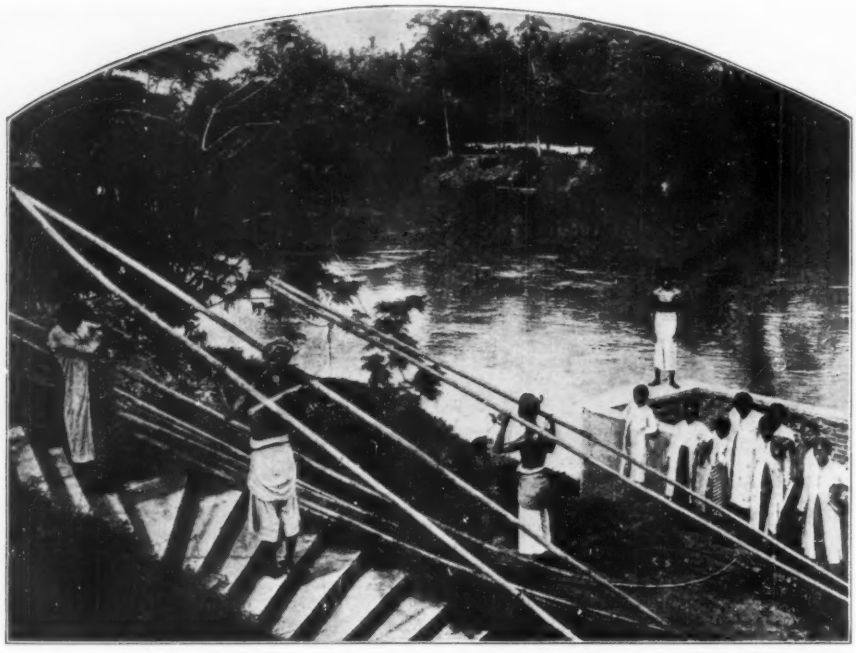
The establishment of the American Bemberg Corporation plant in 1927 in Elizabethton, within two years time transformed a sleepy little village of 2400 inhabitants into a flourishing industrial town of 12,000. Thousands of mountain folk on foot, on mule, and on horseback followed in the wake of science. Thousands of men and women set themselves the task of feeding and tending the giant mechanical silkworks. Thousands who had watched the spider spin his silver web in the blue-green shadows of southern hills, engaged in the task of spinning, with steel fingers, the same infinitely fine filaments at the foot of Smoky Mountain.

The spider toils on, weaving nets to trap his prey. The industrial chemist also toils on, weaving silken garments for the Colonel's Lady and Judy O'Grady, displacing the old with the new, displacing spider and silkworm with men and machines.



Inspection under the microscope of the internal structure of natural and artificial silks shows the filament contours.

At the left is Bemberg filament; in center, natural silk; and at right, viscose rayon—all magnified 300 times



Transporting bamboo to the market. Often it is floated down the river, then carried by the natives

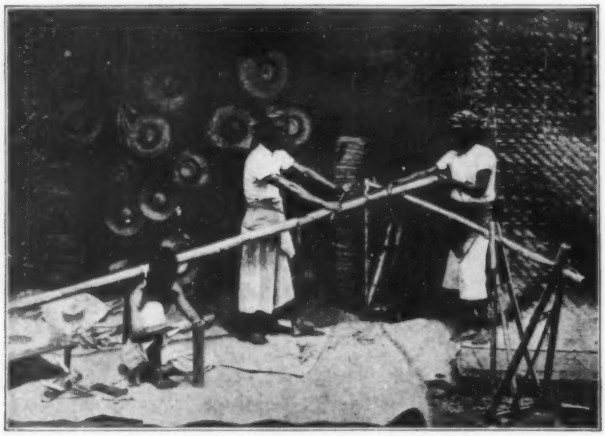
By HENDRIK de LEEUW

'Panama' Hats From the Pacific

THE American farmer who uses the old-fashioned floppy "straw" hat does not realize that he is perhaps indebted to the deftness of slim brown hands in the far off Dutch East Indies for the sunshade that protects him from the blistering sun. Likewise, milady of New York, London, or Paris may not be aware of the fact that her blocked, or basket-weave, or rough "straw" is from the same source. Hats of many different shades and colors, in almost countless models and shapes, and of a variety of materials—15 to 20 millions of them—are made yearly in these distant islands for the markets of the world. The United States purchased over 8,000,000 of one kind in 1927.

The Dutch East Indies are richly endowed by nature with the materials of which these hats are made. Bamboo in many varieties is found in Java, Madura, Bali, and Lombok; rattan in the outer islands; pandanus in Sumatra; lontar palm in the eastern archipelago; and various grasses in many localities. Pandanus grass has long, strong leaves and is famous for its use in the Sumatra solid plaiting. Lontar leaves have long been used by the natives as writing paper, while in the Celebes and in Borneo, the natives have used *foeja*, or beaten bark, in their crude cloth and hat manufacture. In fact, the various fibers and growths of the jungle play an important role in the lives of the natives. The young roots of the sago palm and twigs of the liana serve as material for baskets, mats, and crude harvest hats; unopened leaves of a wild banana are used in making garments; and other fibers, leaves, and bamboo strips are fashioned into fishing nets, cages, ornaments, war garb, old-fashioned payongs (umbrellas), and so forth.

The hat industry, so the story goes,



Bamboo is harvested before the branches bud, cut into lengths of six or seven joints each, and then scraped

The natives cut the bamboo into blades and these are split again and again until divided into thin strips

dates back to the 1850's when a Chinese migrated to the Dutch East Indies from the Philippines, at that time the center of the hat industry. He settled in Tangeran, in Java, about 14 miles from Batavia, and started in a small way the manufacture of so-called Panama hats. As the new industry showed signs of a lucrative future, a Frenchman named Petitjean took it up on a larger scale. Rivalry ensued and the competition stimulated the growth of the business until it had spread to all the islands.

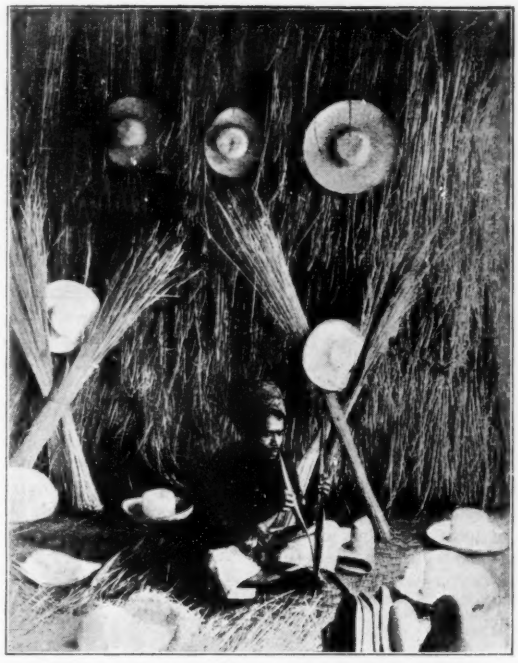
THE hats originally produced were rather crude, but as the industry developed, more up-to-date methods were adopted although the greatest part of the work is still carried out in the homes of the natives. The whole family assists in the work, the men usually preparing the material while the women and children do the plaiting of hats. The men do the final stitching and ironing.

In making hats of bamboo strips, the bamboo stalks are cut before the branches bud and are carefully handled, since bruising causes red spots. Those that are floated down the river are used for inferior hats because they re-reive many injuries. And although bamboo is plentiful in the islands, most plaiters buy it in the markets.

In preparing bamboo for plaiting, the stalks are first cut into pieces six or seven joints long and the green rind is removed. These pieces are exposed to the sun and the dew of night to whiten them. The following day they are split into blades three or four inches wide. These, in turn, are split into laths about one inch wide and the splitting is continued until finally five to nine strips are obtained from one piece. After a further exposure to the sun and dew—to make the strips flexible—they are divided into "straws" by means of a wooden or a bone knife.

At this stage, a peculiar thing happens. The prepared bamboo "straws" are sent to Europe for bleaching by a jealously guarded secret process, and are then returned to the islands for plaiting.

The pandanus grass leaf is prepared for plaiting by removing the midrib, cutting the halves thus formed into strips, and removing the outer surface of the leaf. The strips are then boiled for a night, dried, and also sent on a trip to Europe for bleaching. The grayish fibrous leaves resemble raffia at first, but when finally ready for plaiting, they assume the creamy white color of the Panama hat.



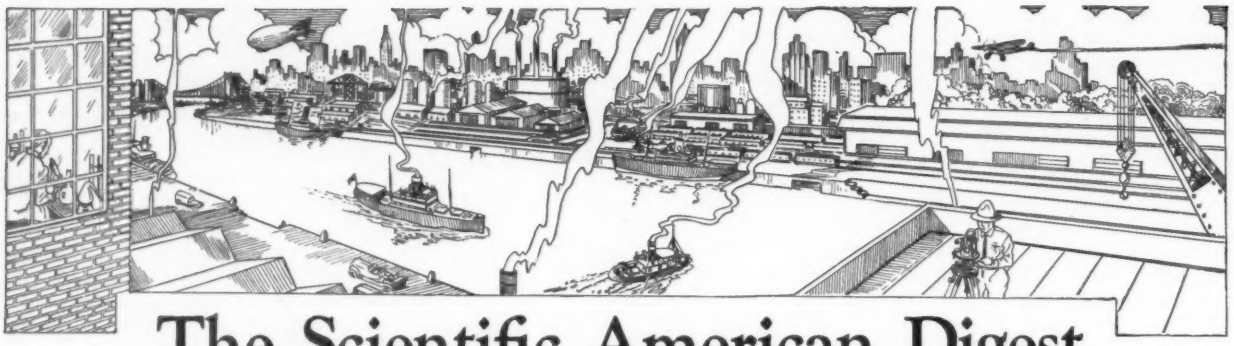
Further splitting. Prepared material, together with several finished and one unfinished hat

A hat of ordinary quality generally takes about two days to manufacture. One of higher quality may require four days or even longer. In plaiting them, the crown is begun first on a round board in which a flat-headed nail has been driven as the central starting point. Only the most experienced plaiters do the work on the apex of the crown. As the plaiting progresses, the hat is placed upside down on a board through which there is a hole large enough to receive the crown. The "barrel" of the crown is then plaited within this hole, which acts as a pattern or guide for the size. When this is finished, the brim is plaited flat or curled, as may be desired. Finally the hats are washed, air dried, and packed for shipment.

Besides going to countries of the western world, hats from the Dutch East Indies are sold to Australia for the fruit pickers—in this case being one yard in diameter, to the Orient in fez shape, to Singapore for children, and to many other places in the form of topees, blocked, unblocked, bleached, or colored hats. Many of them are lined with inserted hats of coarser variety, the brims being woven together at the edge.

Native women doing the intricate work of plaiting, at which they are very proficient. Their hands move so fast that one can hardly see their movements

IN the Dutch East Indies, there are as many styles of home-made hats as there are tribes. One finds in some localities, hats with beaded borders; in others, hats beautifully embroidered with gold or other precious metals and used by native princes. Some of the Dajak tribes make plaited hats with intricate decorative patterns worked into them. Some of these are worn only by persons of high standing or are given the dead to take with them to "Apo Kasan," the Dajak hereafter. The *songko*, a flat, stiff, bamboo-plaited cap—also sometimes made of lontar fiber—is the original headgear of the certain tribes of Celebes and is worn by grandees and officials. It is often elaborately embroidered with gold and silver braids. Select specimen's of the native hatter's art become heirlooms and are presented to married couples as prized gifts.



The Scientific American Digest

Conducted by F. D. McHUGH

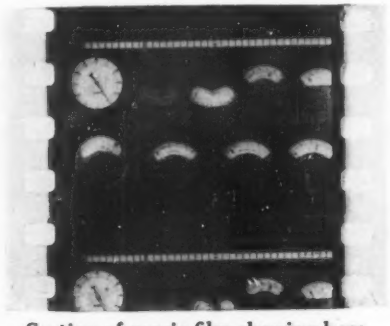
Contributing Editors
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

MORRIS FISHBEIN, M.D.
Editor *Journal of the American Medical Association*, and of *Hygeia*

Movie Camera as an Aid in Testing

ENGINEERS, whatever their field of operations, often are required to carry out tests of various kinds where it is necessary to read a number of meters simultaneously. In such cases, several men may have to be employed to do the reading at each recording period but the results



Section of movie film showing how meters are read by photography

obtained are frequently difficult to co-ordinate. Should the test extend over, say a six-hour run, and five-second or half-minute readings be required, then the observers would probably make trouble.

This is the substance of an address presented to the Association of Certificated Mechanical and Electrical Engineers, of South Africa, by Mr. L. B. Woodworth. To overcome the many difficulties, he advocates the use of a camera, preferably a movie camera, for taking the readings. The accompanying illustration, obtained from Mr. Woodworth, will show at a glance the effectiveness of his method, and anyone familiar with tests of this nature can realize its many possibilities. As will be seen, the record obtained in this manner is permanent and may be filed away for reference at any future time. With the addition to the set-up of an ordinary clock or watch and a placard showing the date, so arranged as to be included in the picture, the resulting record would contain all facts necessary to be known, perfectly co-ordinated, and absolutely accurate. And one man can do the job in but a moment at each recording period.

Fire War on Pests

FIGHTING one forest menace with another is the solution for winning the war with bark beetles, according to David Arrivee, assistant supervisor of Targhee National Forest in Northeastern Idaho. Fire was the medium he and the Targhee forest officers used in exterminating the insects which are as deadly to the trees they infest as fire itself. He explains, in *American Forests and Forest Life*, magazine of the American Forestry Association, the method employed and compares its advantages of speed and reduced costs to the tedious felling and burning of infected trees.

Yellowstone National Park itself might have been infected by the insidious enemy had the officers of Targhee National Forest not been successful in their crusade.

"Unlike fire," points out Mr. Arrivee, "insect infestations send up no black and pungent-smelling smoke signals. The myriads of little black beetles, each smaller than a grain of wheat, show themselves only during the short midsummer mating flight, attack a tree at the rate of one pair for each of the hundreds of pitch tubes that usually exude from the entrance holes on the trunk, and then attend strictly to business under cover of the bark."

Bark beetles work swiftly both in killing the tree attacked and in spreading to others in the vicinity, and their damage is often as deadly as fire. In the race for winning the territory back from the enemy the foresters hit on the scheme of fighting with controlled fire.

"In this treatment," says Mr. Arrivee,

In the war against the bark beetle, the man whose job it is to exterminate the pests, is equipped with a small pump tank of kerosene. He sprays this liquid on the tree, lights it, and burns out the insects

"oil is sprinkled evenly over the trunk of a tree with a small pressure pump carried on the back. The oil is lighted and the tree trunk is enveloped in a sheath of flame, which chars the bark and cooks the beetles, larvae, and eggs. Directing the oil stream quickly up and down the trunk, the treater gives it an even, thin coating, with an extra dash around the base where the bark is thick. Striking a match, he tosses it at the foot of the tree and with the oil stream carries the flame up and around it, placing an additional amount of the fuel as high as he can reach up tall trees to make the fire 'crown' through to the tip."

That this method is economical as well as efficient is borne out by Mr. Arrivee's statement that, "Computing the cost of equipment, labor, hauling, team hire, fuel, camps and supplies, the 1929 Targhee projects cost forty-six cents a tree, compared to the reported cost of $1.70 a tree on similar projects where the method of cutting, piling, and burning is practiced. Also, the oil-burning treatment takes only about one tenth as much time."

The tree, of course, is killed but the insects would do the job anyway and, were they not checked, would multiply and kill many other trees.

Air Traffic Control Systems

THE Aeronautics Branch of the Department of Commerce has appointed a special committee on standard signal systems for airports, in an endeavor to bring about uniformity in such systems. The results of the inquiry so far have emphasized the facts that the existing systems leave much to be desired and that they lack uniformity.

Sirens are in use at a few of the larger airports and are quite effective in conveying information to ground operators. Sometimes varicolored flags are in use. At a western airport, red and green semaphores are operated from a control tower. The Very pistol, red and green illumination of the wind tee, and blinking of the boundary lights are night-signaling methods.

The majority of those canvassed in the inquiry stressed the value of radio communication.

One authority proposes separate areas for landing and taking off, and stop-and-go lights at the head of the take-off runways. An airport engineer favors a visual system complete in itself and aural and radio signaling as auxiliaries. A system employing steam jets to be illuminated at night will be installed at an eastern airport. At another in the middle west it is proposed to install a panel of lights which will indicate the number of planes in the air at any particular time.

The committee invites suggestions from all persons interested in this topic.—*A. K.*

Elmer A. Sperry

ON June 16, Elmer A. Sperry, who has been ranked second only to Thomas A. Edison in the field of American invention, died in Brooklyn, New York, at the age of 69. During an active life, he had taken out nearly 400 patents. Among these, the most notable, perhaps, is the Gyro-stabilizer for ships, a device which he later modified for use on airplanes and aerial torpedoes.

He invented the Gyro-compass which is used widely on ships of many nations, and "Metal Mike," the automatic steersman which keeps a ship on a set course. He applied the gyroscope to airplanes to give pilots an artificial horizon for flying in fog. Some of his other inventions are: systems of street lighting, lighting system for motion picture projection, high-powered searchlights, and electro-chemical processes.

Mr. Sperry was President of the Sperry Gyroscope Company until January, 1929, when he sold out. He was the founder and a charter member of the American Institute of Electrical Engineers and of the American Electro-chemical Society. He was also a member of many of the most important scientific and engineering associations and societies in this country, and had received many awards and medals both at home and abroad.

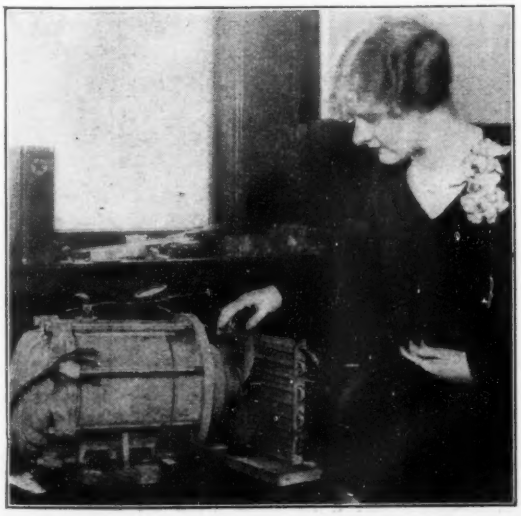
New Alloy in Plumbing Industry

THE British discovery of a new ternary-lead alloy—with which it will be possible to produce sheets and water pipes superior to and cheaper than those made of pure lead, and having only two thirds of the weight, has been announced. The new alloy, which was discovered by the British Non-Ferrous Metals Research Association in the course of investigations to find the cause of breakdowns in lead cable sheathings, consists of 98.25 percent lead, 1.5 percent tin, and 0.25 per cent cadmium. Tests show that it possesses the following advantages over pure lead: Pipes made from it will be cheaper, having only two thirds the weight; its ultimate tensile strength is 84 percent greater; its resistance to vibration is 217 percent greater; in certain corrosive waters its resistance is superior to lead iself.

A ton of ternary alloy costs 10 percent more than lead, taken on the basis of metal costs, but the ternary alloy will give 33⅓ percent greater length and superior mechanical strength of pipe, for the same weight of lead, so that there is a gross margin of saving amounting to 23 percent. There is a small extra manufacturing cost but the net savings make the alloy pipes considerably cheaper. Another saving will be on carriage charges. Lead sheets are subject to "creeps." The tin-lead alloy, which has a greater resistance to corrosion, is 300 percent less ductile than lead.

There seems to be good reason to believe that this alloy will take the place of lead pipes and sheets throughout the world.—*A. E. B.*

This curious animal portrait, found on a maple board in a shop of the Forest Products Laboratory, Madison, Wisconsin, was produced solely by a natural discoloration around a cluster of knots. The teeth and the high light around the eye were produced by reflections from the light used by the photographer



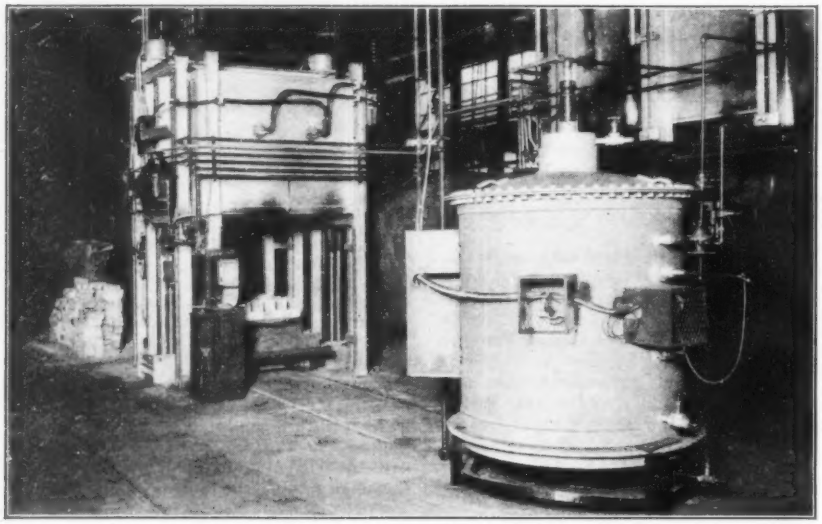
No shaft or belt turns the fan on the new Westinghouse electrical refrigerator. Powerful cobalt steel magnets, a recent development of the company's engineers, whirl the fan around by magnetic induction, through the end bell of the motor housing. The motor armature has no mechanical connection with the outside, as it runs in bearings within the housing. This construction allows the motor housing to be permanently sealed

Food Poisoning

A CONSIDERABLE number of people in Chicago were poisoned after eating cake. It was formerly thought that food poisoning was due to the development of strange chemical substances in the bowel. Recent investigations have proved, however, that the effects are almost invariably due to bacteria or bacterial production. The most serious type of food poisoning is that following the ingestion of the botulism germ or of its poisons. Investigations made by Prof. E. O. Jordan of the University of Chicago have shown that other forms of bacteria likewise produce such

changes. When samples of the cake were brought to the laboratory and subjected to bacteriologic examination, it was found that a staphylococcus of the type that ordinarily causes infection of the skin had developed a toxic substance in the cake and when a filtrate containing this toxic substance was swallowed by human volunteers they developed nausea, dizziness, and prostration, exactly as did the people who ate the cake.

In this experiment 80 feeding tests were made on 58 male volunteers who were mostly between 20 and 30 years of age.



Electric annealing furnace and Electrolene producer

In an attempt to control the psychology of the situation some of the volunteers were given milk without any of the toxic filtrate. Usually there was slight rise in temperature, then dizziness, loss of appetite, weakness in the legs, headache, pain in the abdomen, nausea, and vomiting. Following this there was looseness in the intestinal action and then gradual recovery. Such conditions emphasize anew the importance of careful sanitation in the preparation of food.—*M. F.*

Seamless, Endless Tube Made by Electrolysis

BY forever pulling off the metal sheath as it is deposited out of solution on an iron alloy core, Prof. Jean Billiter of the University of Vienna makes seamless and endless tubing of copper, zinc, and iron.

But this, his first method, was too slow, he told the American Electro-chemical Society in St. Louis recently; only a few inches of tubing could be made in an hour. Therefore a faster method was devised.

A lead core is now run continuously through the solution and metal is deposited on it as the core moves. Then the soft lead is melted away and the copper, zinc, or iron tubing left. A tube five yards long and nearly one tenth of an inch thick can be made in 24 hours.—*Science Service.*

"Electrolene" to Supply Cheap Hydrogen

ELECTROLENE! There's a new, synthetic name for a brand new arrival in the industrial chemical family. An appropriate name it is too, for electricity is its daddy. Electrolene is the name given by F. P. Wilson, Jr., of the General Electric Company to the new industrial gas produced by the latest ingenious contrivance of the famous Schenectady laboratory. The machine will also produce carbon monoxide or carbon dioxide or a mixture of all of them.

Briefly, the Electrolene producer is an electric furnace in which hydrocarbon gases, with or without steam, are partially decomposed to produce mixtures having carbon monoxide, hydrogen, and carbon dioxide as the main constituents. The relative quantities of these gases in the mixture depend upon: (1) The hydrocarbon being treated; (2) The temperature to which it is heated; (3) The amount of steam used.

The hydrocarbon used as raw material may be butane, propane, ethane, city gas in which methane is the principal hydrocarbon, or a great variety of other gases.

There are dozens of operations in the chemical industry where chemists would use large quantities of hydrogen except for the high cost of the gas that forces them to adopt other expedients. Now comes an electrical device which supplies, not pure hydrogen, it is true, but a gas mixture which will, in many cases, do just as good a job, at about one tenth the cost. If methane is fed into the producer operated at 1400 degrees, Centigrade, the result will be hydrogen and CO; if carbon monoxide and steam are fed into it, the Electrolene will be a mixture of hydrogen and carbon dioxide, the proportion depending on the temperature of the producer. The electric heat supply is automatically controlled to maintain any desired temperature, and the steam supply is also automatically regulated for any rate of output, so that one valve controlling the Electrolene flow from the producer is the only part of the equipment requiring manual attention.

In every case an appreciable increase in volume of raw gas supplied appears as Electrolene. In the case of complete dissociation of coke-oven gas with steam one cubic foot of raw gas becomes approximately two cubic feet of Electrolene, having an approximate analysis of 72 percent hydrogen, 23 percent carbon monoxide, and 5 percent of "inerts." From butane, a volume increase of 13 times is secured, the resulting Electrolene analyzing approximately 69 percent hydrogen and 31 percent carbon monoxide. With methane, the volume increase is four times, and the Electrolene analyzes about 75 percent hydrogen and about 25 percent carbon monoxide.

For a great variety of industrial uses, Electrolene promises to be an effective answer to the chemist's prayer for cheap hydrogen.—*A. E. B.*

Canned Salmon Prevents Disease

CANNED salmon contains the substance which will prevent the frightful hard-times disease, pellagra, the United States Public Health Service has just announced. Canned salmon may therefore be substituted for meat in localities where pellagra is prevalent but where meat is scarce.—*Science Service.*

Detecting Dangerous Sewer Gases

ABOUT a year ago, a series of explosions in a sewer in London ripped up pavements and shattered building fronts over a wide area. Just a few weeks ago, a similar explosion in a sewer on Broadway, New York, caused considerable damage. Such accidents emphasize the ever-present danger, not only of serious property damage but also to the men of maintenance or inspection crews due to the accumulation of various gases such as carbon monoxide, ordinary sewer gases, and the fumes from oil wastes, in manholes or sewers beneath our streets.

To check up on this gas accumulation, the Mine Safety Appliances Company has developed the Jones Gas Detector, an easily portable outfit mounted in a small stand. It consists essentially of a bomb in which a spark plug is inserted and to which a pressure gage is attached. In addition, there are the following component parts: A measuring device, cylinder of propane, water cup, aspirator bulb, two dry cells, an automatic spark coil, ignition switch, necessary valves, and so forth. (One cylinder of propane, in compressed liquid state, is sufficient for making approxi-

Testing for carbon monoxide gas in a manhole with an ampoule

mately 300 tests as described below.)

In operating the Jones Gas Detector, a sample of the air to be tested is drawn up from the sewer and forced into the apparatus through a suitable length of sampling line by means of an aspirator bulb. The sampling line is then detached and the aspirator bulb is connected to the rubber inlet tube which traps the sample in a closed system. Stopcocks on each side of the bomb are closed and a spark introduced into the bomb by snapping the ignition switch momentarily to the "on" position and then to the "off" position. In this manner, an explosive gas-air mixture is ignited and the pressure developed by the explosion in the bomb is indicated on a drag needle pressure gage. If no pressure in indicated by this procedure, the sample is enriched by the addition of a measured volume of propane which displaces an equivalent volume of sample. After this propane is thoroughly mixed with the sample by aspirating through the closed system, the stopcocks are closed and a momentary spark is introduced. An explosion in the bomb indicates that the original sample is not less than 75 percent explosive since the measured volume of propane added is equivalent to 25 percent of an explosive propane-air mixture. If no explosion is indicated in the bomb after the first enrichment, it may be necessary to make three more individual additions of propane to the original sample, following the same procedure as with the first to determine if the original sample is approximately 50, 25, or less than 25 percent explosive.

If there is no initial explosion in the bomb and no further explosion upon the addition of a fully explosive concentration of propane, the original sample consists either of an inert atmosphere or explosive gas in concentration above the upper explosive limit. To determine which of these two conditions exists, further simple tests are made according to directions supplied.

To detect the presence of that most treacherous and deady gas, carbon monoxide, the above company produces the M-S-A Carbon Monoxide Detector Ampoule. This consists of palladium chloride in an acetone-water (non-freezing) solution, sealed in a small glass tube which is surrounded with absorbent cotton. The ampoule is first attached to a string, crushed between the fingers until the cotton is fully saturated by the escaping solution, and then suspended in the manhole for 10 minutes. The solution turns the cotton a yellow color. In the presence of carbon monoxide, it turns black. The degree of grayish or black discoloration, compared to a chart, indicates the carbon monoxide concentration. It is claimed that concentrations as low as .03 percent can be determined with this ampoule.

At the left is a fingerprint raised from the irregular neck of a bottle by means of the new fingerprint lifting tape. At the right is the same print (reversed) as it appeared when the lifted print was photographed on bromide paper enlarged for comparison

City Trees Often Gassed

SHADE trees need pure air just as people do. Trees are often killed by illuminating gas from leaky pipes in the soil, says the United States Department of Agriculture. Recent experiments show that gassed trees may be saved, if they have not been exposed too long, by forcing air or oxygen under pressure, through a specially constructed nozzle, well into the ground at different points around the tree so as to displace the gas. It will be necessary, of course, to find and stop the gas leak or the procedure will have to be repeated.

Fingerprint-Lifting Tape

A SPECIAL tape of black rubber which simplifies the raising of a latent fingerprint, has recently been invented and patented by Major Richard M. Joyce, Superintendent of the Bertillon and Criminal Identification Bureau of the St. Louis Police Department. Latent prints are to be distinguished from those intentionally made on suitable surfaces for record purposes; they are those which are inadvertently left behind by criminals at the scenes of their crimes.

The old photographic method of obtaining permanent records of latent prints has many disadvantages. Prints left on curved, angular, or reflecting surfaces or in restricted recesses are almost impossible to photograph, and when a camera is used the resulting images are distorted or indistinct. By Major Joyce's method, the print is first powdered with aluminum bronze powder, the tape is pressed over this, and the gleaming print is lifted. The image is then covered with a transparent shield which protects it until it may be conveniently photographed.

This new transfer system extends fingerprint recording facilities to small towns or rural districts not able to purchase and operate the usual photographic equipment.

Aluminum in Colors

WHILE aluminum, together with its alloys, has been adopted for a wide variety of uses, (see SCIENTIFIC AMERICAN, June, 1930), its many possibilities have only begun to be realized. With the production of aluminum in colors by a recently developed process, some of the advantages of the metal have been enhanced and some of its disadvantages overcome so that interesting new fields for its application have been opened up.

Colored aluminum, called Alumilite, was developed by the Metals Protection Corporation. The process is an electrolytic method of applying protective and decorative coloring to aluminum and its alloys, the colors available being silvery white, jet black, and various shades of red, blue, yellow, brown, green, and purple.

The developing company makes the following claims for the new product:

The coating is an integral part of the aluminum itself, will not crack or peel, and sheets so treated may be stamped and formed into such shapes as camera bodies, hub caps, trim, et cetera, without marring the finish. Alumilite offers unusual resistance to atmospheric and salt-water corrosion; and although not recommended for use in protecting aluminum against acids and alkalis, it is effective against certain

The gas detector which measures the accumulation of deadly gases in sewers

chemicals. Alumilite will not withstand cutting by a sharp instrument but offers considerable resistance to it. A blunt instrument will force the coating into the softer metal beneath without rupturing. Alumilite-treated metal can be heated above the melting point of aluminum, 1214.6 degrees Fahrenheit, and the metal within will melt while the coating remains intact. The treated aluminum surface will absorb certain lacquers as well as oil and is, therefore, a good base for such materials; ordinary aluminum is not.

Some of the suggested uses of Alumilite are: cameras, scientific instruments, novelties, electrical appliances, switch plates, fittings, automotive trim, airplane propellers, marine equipment, optical goods, toys, aluminum shingles, and many others. Black, for example, has been suggested for the bottoms of cooking utensils, since black absorbs heat more readily than any other color. Water in an aluminum kettle blackened by the Alumilite process will boil in much less time than in a plain aluminum kettle.

Alumilite has been adopted by many large firms for use on their products; by the Navy Department for use on airplanes, submarines, et cetera; and by Army aircraft engineers for use on Army airplanes.

Overweight Children

THE fat baby has always been a pride to its parents, but the fat child of eight to 20 years of age is a problem for its parents. Many cases of fatness or obesity are due to disturbances of the glands of internal secretion, or to the fact that the body does not dispose properly of the material that is taken into it. In many instances, children are fat because the parents and grandparents were fat. This is known as constitutional obesity and is the type that is absolutely resistant to all treatment. In those cases of obesity due to glandular disturbances, the basal metabolic rate or the rate at which the body carries on its chemical process is lower than it should be. However, in many cases of constitutional obesity the basal metabolic rate seems to be normal.

Drs. Anne Topper and Hannah Mulier have made a study of the basal metabolic rates of 35 boys and 35 girls whose ages ranged from six to 14 years, but whose weight exceeded normal by from 13 to 75 percent. In many cases there was a definite indication that the children had been overfed. Naturally only a few confessed to laziness. In some cases the obesity followed recovery from acute infectious diseases or following removal of tonsils or the appendix. In the large majority of these cases, however, it was found that the metabolic rate was normal, in a great many cases being toward a high normal rate. The authors believe that the tendency toward a high normal rate is probably due to overfeeding and to the fact that the body is forced to speed up its activities in order to take care of the excess food.

It should be recognized that these examinations were made in many instances just before the time of adolescence when the child begins to change toward the adult type. At this time the glands in the body undergo various changes and these changes may be associated with the rather high increase in the speed of metabolism.

Obviously, the practical lesson to be derived from this discussion is the necessity of determining how much food is necessary to keep the child at normal weight and thereafter to avoid overfeeding.—*M. F.*

Light Alloys

THE lightest element solid at ordinary temperatures is the metal lithium. It is only a little more than half as heavy as water. While technically a metal, it is too soft to be of any use in the ordinary applications of metals and too active chemically, for it tarnishes rapidly in the air and is completely changed by contact with water, which it decomposes.

In recent years, however, says R. M. Santmyers, of the United States Bureau of Mines, considerable research has been made to determine the possibilities of alloying lithium with other light metals such as beryllium and aluminum. A patent has been issued to Frank A. Fahrenwald for an alloy of extreme lightness, fair permanence, and considerable hardness, in which the component parts were lithium and beryllium. The beryllium protects the lithium from oxidation by moisture or heating and from further action if oxidation has begun, by producing upon the surface of the alloy a closely adherent, finely textured insoluble oxide that prevents further oxidation. The lithium content may be as high as 25 percent. This alloy apparently does not corrode faster than iron, and its specific gravity is only about 1.5.

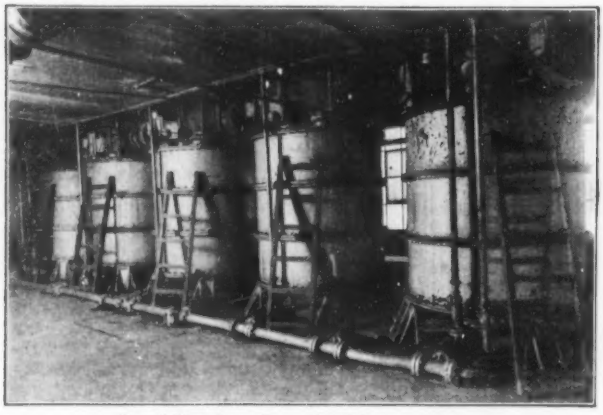
By increasing the proportion of lithium to about 65 percent, an alloy as light as water can be produced, and although such an alloy corrodes fairly rapidly in the presence of water it can be protected sufficiently for many purposes by plating or covering. If the percentage of lithium is increased slightly above 65 percent, small quantities of aluminium or zinc may be added to increase the hardness and strength, but the alloy will retain a specific gravity little or no greater than that of water.—*A. E. B.*

Making the Sparkle for Soft Drinks

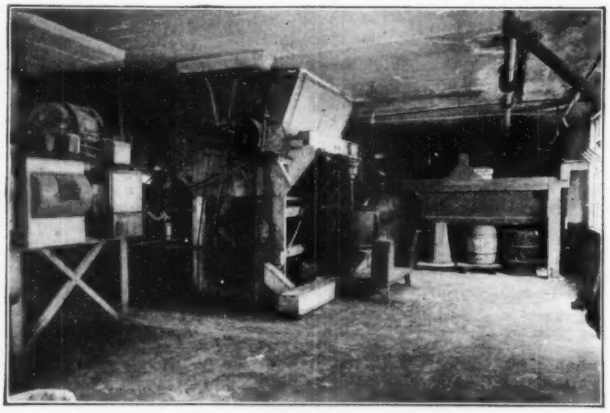
IN these hot summer days, the soft-drink dispensaries once more come into their own, and it is an appropriate time to consider the chemistry that creates the sparkle or "fizz" in the bottled beverages that quench the great American thirst. The sparkle is due to dissolved carbon dioxide gas—the gas that gives soda water its effervescence. While carbon dioxide is one of the most abundant gases in nature, being generated wherever coal or wood is burned, its manufacture for beverage purposes presents certain problems to the chemical engineer which are described by W. P. Heath in a recent issue of *Industrial and Engineering Chemistry*.

"Before prohibition," says Mr. Heath, "carbon dioxide was collected and compressed as a by-product of the fermentation of beer. The most recent method is to pipe it from wells. In California, prospectors drilling for oil ran into large pockets of carbon dioxide under pressure. Under government lease these pockets are now yielding their store of carbon dioxide. Most of the gas thus collected is used in the manufacture of solidified carbon dioxide. Perhaps the most universally used process today is the coke process, whereby carbon dioxide is collected as a product of the combustion of coke under forced draft."

In Atlanta, because of the proximity of raw materials, the Crystal Carbonic Laboratory uses the wet process, with dolomite, sulfuric acid, and water as raw materials. The stone called dolomite is most suitable on account of its freedom from excessive amounts of oxide of iron and alumina, carbonaceous matter, sulfides, and silica. The stone is pulverized and then treated with sulfuric acid. Carbon dioxide is given off rapidly, and the gas is piped to a 2500-cubic-foot rubber gas bag in the basement, where it is ready for compression. The gas is drawn from the gas bag into a three-stage compressor where the pressure is



Lead lined carbon dioxide generators

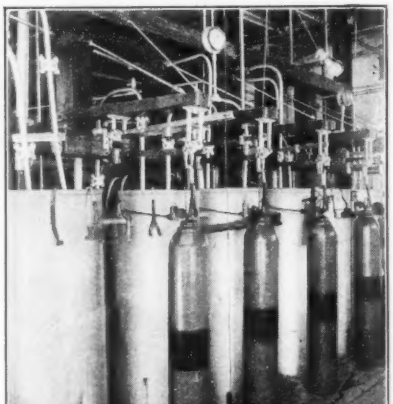


Driers and screens for Epsom salts

stepped up to 75 pounds in the first stage, 250 pounds in the second stage, and 1000 pounds or more in the third stage. The third stage of this machine is of the solid-plunger type, outside packed, and the gas emerges at over 1000 pounds pressure into brass cooling coils, where the temperature is reduced to below 88 degrees, Fahrenheit, the critical point of carbonic acid. The gas is then forced into 50-pound steel drums. Gases under pressure are classed as hazardous and the filling is carefully regulated so that all excessive pressure may be avoided.

At ordinary temperature the drums are about two thirds full of liquid and one third full of saturated gas. The average purity is 99.5 percent and there are traces of air. Such impurities as may give an odor or taste are not permitted in carbonic acid to be used in the beverage industry.

One of the most interesting features of this process is the fact that it produces Epsom salts as a by-product. The dolomite contains 45 percent of magnesium carbonate, and after the sulfuric acid has acted on this substance, releasing the carbon dioxide gas, there remains a solution of magnesium sulfate—Epsom salts. Although the Crystal Carbonic Laboratory is primarily in the business of manufacturing carbon dioxide for use in the beverage industry, the quantity of magnesium sulfate obtained as a by-product makes this company one of the largest Epsom salt manufacturing concerns in the United States.—*A. E. B.*



Compressed carbon dioxide being loaded into cylinders for shipment

Bread

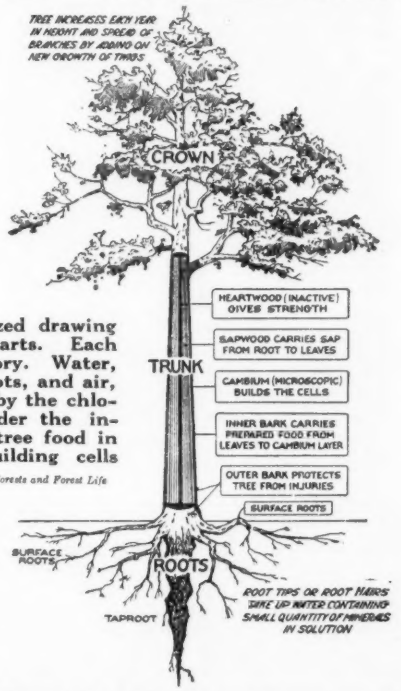
THE battle of cultists against white bread continues. The millers oppose the attacks by pointing out that the American people seem to prefer white bread to whole wheat bread. Furthermore, they are annoyed because there has been a general decrease in the consumption of cereals, since these represent a cheap source of energy and the American people have become accustomed to expensive diets. The bread of today is not the bread of the past generation. Today it is made by the addition of milk, nuts, raisins and other substances which add greatly to its nutritious value.

Whole wheat is preferred by some because of its bran content and its greater proportions of vitamins, due to the fact that the whole wheat germ is present. On the other hand, whole wheat bread does not keep well and the bran is irritating to persons having inflammations of the gastro-intestinal tract.

Under the auspices of the Medical Research Council in Great Britain, Drs. R. A. McCance and R. D. Lawrence made a special study of this problem. Their views are succinctly stated:

"In advocating whole-meal bread for general use, whether in times of need or in times of plenty, it should be remembered that not only men but also women and children are concerned, and that all the experiments on which the arguments are based have been carried out on animals or adult males. Children are very intolerant of high cellulose diets, and, for some, brown bread is far too irritating, even if given with the idea of relieving constipation. Appetite is such an important factor in all digestive considerations that no one who dislikes a food of unproved value should be forced to eat it if it can be avoided. In time of peace, of course, the grown-up population, if they have the choice, will never eat whole-meal bread unless they like it, no matter how specious the advertisement, but they may force their children to eat it in the belief that they are doing them good. One should, therefore, be cautious in advising whole-meal bread generally, and wait until careful unbiased experiments have been done on a sufficient number of men, women, and children. Thus only can accurate conclusions be drawn."

It must be remembered that man does not live by bread alone. In a suitable diet, bread constitutes only a single part and is supplemented by meat, vegetables, fruits, and many other cereal products. In the light of present dietary habits, there seems to be no reason to believe that white bread is in any sense of the word a harmful constituent of an average diet.—*M. F.*


TREE INCREASES EACH YEAR IN HEIGHT AND SPREAD OF BRANCHES BY ADDING ON NEW GROWTH OF TWIGS
CROWN
TRUNK
HEARTWOOD (INACTIVE) GIVES STRENGTH
SAPWOOD CARRIES SAP FROM ROOT TO LEAVES
CAMBIUM (MICROSCOPIC) BUILDS THE CELLS
INNER BARK CARRIES PREPARED FOOD FROM LEAVES TO CAMBIUM LAYER
OUTER BARK PROTECTS TREE FROM INJURIES
SURFACE ROOTS
SURFACE ROOTS
ROOTS
TAPROOT
ROOT TIPS OR ROOT HAIRS TAKE UP WATER CONTAINING SMALL QUANTITY OF MINERALS IN SOLUTION

How a tree grows: A partly sectionalized drawing showing the functions of the various parts. Each leaf is essentially a tiny chemical factory. Water, with its dissolved minerals, from the roots, and air, which the leaf breathes, are acted upon by the chlorophyll—the green coloring matter—under the influence of sunshine and the result is tree food in the form of sugars and starches for building cells

Courtesy *American Forests and Forest Life*

Navigation in the Air

AERIAL navigation is not a matter largely of astronomical observations. It is, particularly for cross-country work, a matter of dead reckoning, with compass, drift and speed indicators, and a few simple calculations as its basis. It is not a difficult art, but an immensely important one. The subject is splendidly covered in "The Navigation of Aircraft," by Lieutenant Logan C. Ramsey, U. S. N., himself a naval aviator and an acknowledged authority on aerial navigation.—*A. K.*

A Novel Landing Float

IN *Aviation* is described a novel form of semi-circular "button" float which has been placed in use on the Air Ferries [See page 379, May 1930 SCIENTIFIC AMERICAN. *Editor.*] between San Francisco-Oakland and San Francisco-Vallejo; more than 85 landings are made on it daily.

The float is rigid, with a smooth rounded top which slopes gradually into the water. A sand surface is provided to keep the planes from skidding. The float is supported by a pontoon and fitted with an overhanging platform. Along the rim are four solid ballast pockets to regulate the depth still more accurately. At the water line 18 buoyancy tanks are installed to correct any tendency of the float to be too lively. The surface of the float is a variable curve for the purpose of breaking rough water and to give maximum freeboard.

The weight of the float is 100 tons and it extends 4½ feet under water. It is built of creosoted Douglas fir and is moored by a cable from a king post to keelsons leading to the rim and then to anchorage. It cost 10,000 dollars to build.

When the amphibian alights on the water, its wheels are dropped and it climbs out of the water on to the button under its own power. It can approach from any direction without the help of landing crews, and can also make a get-away unaided.

Experiments have shown that a complete circular float, slowly rotated, will divert the wave, kill a hollow and make the approach of the plane easy even in a high sea. This makes the use of the float promising even at sea.

It was developed by B. L. Haviside and Joseph J. Tynan, Jr., both of San Francisco, and is arousing much interest.—*A. K.*

Max Valier: Rocket Martyr

THE month of May saw the sad crash of Max Valier in a venturesome plane flight propelled by liquid rocket. The whole fuel charge detonated at once.

The internal combustion engine, the cannon, and the rocket are all heat engines operating on the same fundamental calorific principle. A 16-inch shell, for example, has the energy of an express train; a rocket may possess the energy of an ocean liner.

In the 90's a German and a Russian (Ziolkowski) were developing on paper the concept of space ships, rocket-propelled;

and in 1913 Robert Esnault-Pelterie, the distinguished creator of the French aeronautic engine, delivered a mathematical paper on "Astronautics" before the St. Petersburg Academy. The science, or art, has been more fittingly renamed by a German "Kosmonautics."

Parallel, then, with the laboratory work of our own Dr. Goddard, a close group of Germans and Austrians, and a corresponding group of Russians of the Hydrodynamic Institut, have been working systematically toward the solution of the problem. In the German group were prominently: Dr. Oberth (Hirsch-REP prize 1928-9); Ingr. Hohman (Honorable Mention); Max Valier, Ingr.; Fritz Opel, manufacturer; A. Scherschewski; Sander, pyrotechnist; Willy Gail and Frau Harden, writers; Rhoen-Rossiten Gesellschaft; pilot Stammer, and a number of others. Their headquarters are at Breslau. The UFA has collaborated, and even made a "moon" film. The equivalent American society is the American Interplanetary Society, at the American Museum of Natural History.

Mr. McEachron with a sectionalized Thyrite lightning arrester

Valier was the principal proponent of working toward the space craft or vehicle from the known forms of surface or air craft. For example, he proposed first to drive a boat with rockets (which Opel tried); then an automobile (reported speed 230 miles per hour); then a rail car (reported speed 300 miles per hour); then an ice sledge (still faster); and recently a light plane (60 miles an hour by Stammer, July 1928, the first man so to fly). Valier at the time of his death was substituting oil fuel for gunpowder in the expulsive jet, preparatory to hopping the channel at a speed hoped to be about 100 miles per hour.

A National Advisory Committee report has demonstrated that jet propulsion is not efficient at aircraft velocities—indeed at less than the speed of sound, for flame jets. But beginning with projectile velocities, and up to a mile or so a second, the jet principle approaches an efficiency of 70 and 80 percent, or better than any other heat engine. It is this happy circumstance, more than any other factor, that gives one confidence in the ultimate solution of Kosmonautics.

The name Valier should be placed beside those of Icarus and Lillienthal.

Two Freak Metals Find New Uses

TWO rare metals, caesium and rubidium, formerly known as chemical curiosities, have found their first important commercial use as a result of the development of radio and photo-electric cells. Both these queer metals, members of the alkali group, are soft enough to be cut with a knife and have to be kept in a vacuum, else they ignite spontaneously, due to their extreme chemical activity. This very property is now being utilized in the manufacture of radio tubes. The caesium is introduced into the tubes in the form of chloride, mixed with magnesium or calcium, and compressed into small tablets or "pills." At one stage in the manufacture of the tube the pill is flashed, eliminating the last trace of air and thus securing the desired vacuum. The caesium chloride supplies positive ions at the surface of the filament.

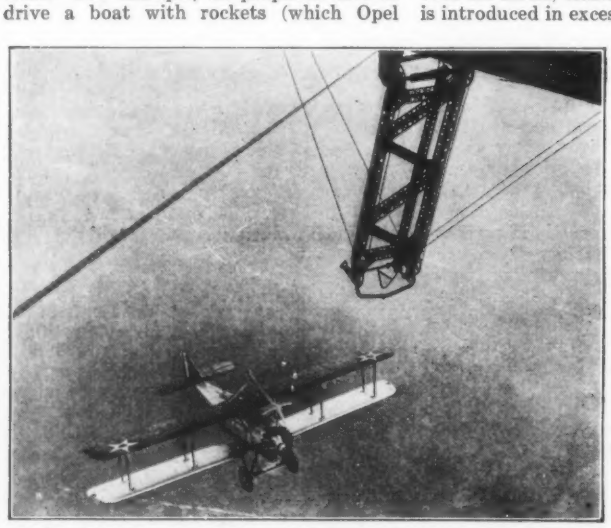
Both caesium and rubidium are employed to a limited extent in the manufacture of photo-electric cells. Rubidium, however, appears to be more suitable for this than caesium, because an extremely thin layer can be applied on the inner side of the glass. In the manufacture of these cells the metal, either caesium or rubidium, is introduced in excess but later is removed entirely except for the molecular layer that has formed on the silver or other base-metal electrode. The photo-emission of the molecular layer is greater than that of the massive metal.—*A. E. B.*

Thyrite—Both an Insulator and a Conductor

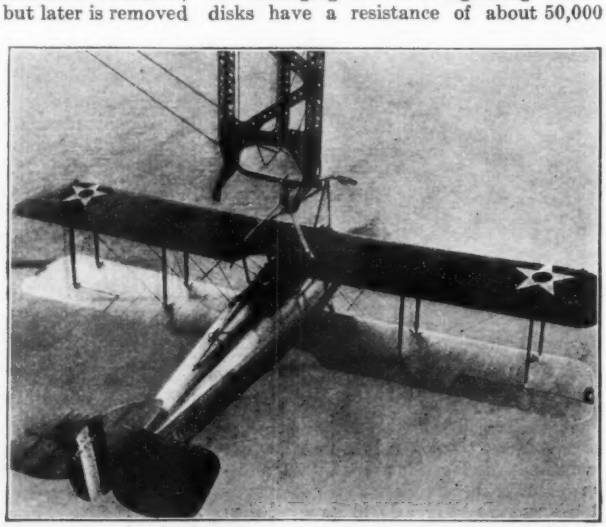
AN entirely new type of material, one that is both a good insulator and a good conductor of electricity, was announced by K. B. McEachron of the General Electric Company recently in New York City. This material, which has been called Thyrite, meaning gate or valve, has the remarkable property of changing its resistance to the flow of electricity as the voltage or pressure is changed. This change in resistance is such that each time the applied voltage is doubled, the resistance decreases so that the current flow is increased more than 12 times. This means that if the voltage is increased 16 times the current flow is increased more than 25,000 times.

The usual conductor with which electrical engineers are familiar does not change in resistance except when the temperature of the conductor changes. To illustrate: the tungsten filament in the Mazda lamp increases its resistance considerably as the filament heats up; the carbon lamp shows, on the contrary, a decrease in resistance as the filament increases in temperature. With either of these materials the resistance change is slow since it depends on the time required to heat the filament. Unlike any materials now in commercial use, the resistance change of Thyrite does not depend on the temperature, but on a change in the applied voltage. Thyrite will change its resistance as quickly as the applied voltage changes; in fact, tests have shown that the resistance can be decreased to a millionth of its original value in a time as short as a millionth of a second.

Thyrite is a manufactured product which required more than five years of intensive research to develop to the state where it can be produced commercially. Mr. McEachron exhibited some disks six inches in diameter and three-fourths of an inch thick, made for use in lightning arresters for the protection of power stations against the damaging effects of lightning. Such disks have a resistance of about 50,000



The dural framework which extends from the lower part of the airship frame, and a plane maneuvering for "hooking" position. Tests of the device were successful



The slight impact that ensues after hook and bar meet is evidently sufficient to adjust hook so that it is securely attached. Note construction of plane hook

ohms when 100 volts are applied to the parallel faces; the resistance decreases to less than one half an ohm when the voltage is increased to 10,000 volts. These disks of Thyrite will carry lightning discharges as heavy as 30,000 amperes without any sign of distress.

The characteristics of Thyrite are permanent. Some of the first material made is still on life test, with no change in its characteristics, even though it has been carrying current continuously night and day over a period of several years.

Thyrite resembles black slate in color. It has mechanical properties similar to those of dry-process porcelain. In manufacturing it, the material is moulded to the shape required, and the contact surfaces coated with metal by the Schoop metal-spraying process.

It is possible to use the material successfully on any alternating or direct current circuit; it is necessary only to supply a proper amount of the material so that it will not become overheated.

In connection with lightning arresters, Mr. McEachron explained that the use of Thyrite allows a considerable reduction in the space occupied by the arrester, and that it is possible to calculate its performance accurately. This feature will be of great assistance to engineers using such protective equipment. Furthermore, it was pointed out, it is possible for anyone to determine the characteristics of Thyrite over a considerable current range, without the use of expensive equipment.

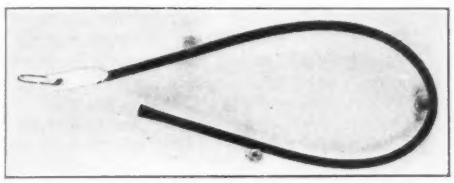
Aeronautical Equipment

THE Curtiss-Wright aeronautical equipment catalog of some 250 pages is a comprehensive compilation. Nothing gives a better idea of the number of things that go to make up aviation: airport equipment, books and maps, cable and wires, clothing, engines and engine accessories, fuels and lubricants, instruments, landing gear and parts, propellers, and so forth. It is a catalog which should be in the hands of every pilot and plane owner.—*A. K.*

Launching Planes from Airships

ONE of the two accompanying photographs shows a Vought UO-1 Navy Observation plane approaching the *Los Angeles* prior to "hooking-on." The airplane is provided with a frame superstructure into which the weight of the airplane is transmitted without undue local stresses being set up. At the top of the superstructure is a hook which has apparently some flexibility and is controlled by a sort of large spring. From the lower part of the airship frame there extends a dural framework, suitably braced with wire and carrying a bar at its lower end.

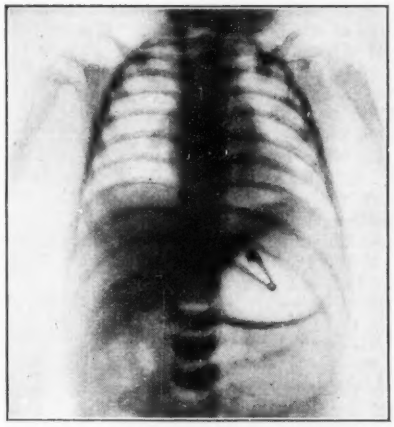
When the airplane is about to be hooked on to the airship, the speeds of the two types of aircraft are synchronized and the pilot feels his way cautiously until he can get the hook on to the bar. When the plane is to be released the bar is pulled away. Demonstrations of the hooking-on and releasing of the plane have been made several times on the *Los Angeles* and have been entirely successful. The hooking-on process enhances greatly the military value of the dirigible. The airplane, having a seped of twice that of the airship, is valuable as a scout for transmission of information to the fleet, and also provides the airship with protection against enemy heavier-than-air craft.—*A. K.*



The rubber tube with which a safety pin was removed from the position in a patient's stomach as shown in the illustration above at right. It was not necessary to open the wall of the stomach although the abdomen was cut open

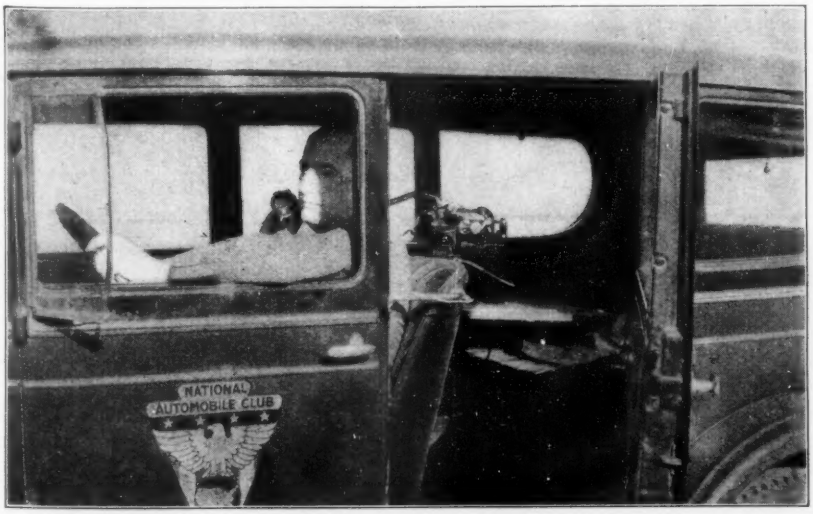
A Pin in the Stomach

WHEN an open safety pin is swallowed it constitutes a serious menace because of the danger that it will penetrate the wall of the stomach and set up peritonitis. So serious is this possibility that not infrequently the patient is operated on immediately and the stomach opened in order that the pin may be removed.



An open safety pin in a patient's stomach as revealed by the X ray

In a case treated recently by Dr. W. B. Huff a technique was devised which enabled the condition to be handled without opening the wall of the stomach. Ingeniously the doctor introduced into the esophagus a rubber tube with a piece of gauze at the end. The abdomen was opened, the pin felt with the fingers, and then, without opening the stomach, the pin was fastened to the gauze at the end of the rubber tube and closed. The rubber tube was then slowly withdrawn, bringing the safety pin with it. In the instance described the child recovered without further disturbance. The method seems to be of value particularly because it permits proper handling of the condition without opening the stomach wall.—*M. F.*



When road "logging" with the Ediphone, the driver does not have to stop his car every time he wishes to make notes; he dictates his notes as he drives

Ediphone Used for Road "Logging"

LATEST road information for the members of the National Automobile Club, San Francisco, is being gathered in a unique, modern, and efficient manner through the utilization of the Ediphone. Traveling in an automobile equipped with an Ediphone operated by a six-volt battery, a very satisfactory trial trip proved the possibility of this method of road "logging," as the collecting of data on road conditions is called.

Instead of the necessity for bringing the car to a stop or, at least, greatly reducing the speed, for the purpose of making notes, this new system enables the driver to record conditions while traveling at the usual rate of speed. Covering ground as rapidly as safety and the condition of the road will permit, the driver may collect such details as mileages, cross roads, grades, road conditions, and a general description of the country traversed. This information is recorded on the cylinder for later transcription into a typewritten report for use in the drafting of maps and the distribution of touring information to club members.

Strength of Prehistoric Monsters Dwarfed by Huge Testing Machine

THE supposed strength of the prehistoric dinosaur is dwarfed beside that of a huge testing machine installed recently at the University of Illinois.

This machine crushes steel and concrete

with as much ease as a human mashes a piece of dirt beneath his foot. It stretches iron rods as if they were taffy candy. In fact, it can exert as much as 3,000,000 pounds in either tension or compression, either to pull things apart or to squeeze them together.

Building beams 35½ feet long can be tested. The screw that is used to concentrate the great pressure is more than 57 feet long and one foot in diameter. The machine stands nearly 50 feet above floor level and extends 14 feet below. It weighs 140 tons.—*Science Service.*

Electrical Water Heater

AN automatic, electrically operated water heater for which high efficiency and low cost of operation are claimed, has recently been placed on the market under the trade name Electromatic. It is adaptable for use in homes, apartment houses, doctors' offices, barber shops, beauty parlors, soda fountains, and so forth. Once it is regulated for the temperature desired, it maintains that temperature without any further attention.

The "heart" of this system is the heating element which is immersed in oil in a vacuum tube which extends down through the center of the tank. From this, a lateral tube leads off to the thermostat control which is operated by a mercury tube. Directly above the mercury tube is the switch which turns on and cuts off the electrical supply. The cold-water supply enters the tank through an inlet near its base while the hot-water outlet is at the top. The tank is well insulated against heat losses, the material used for this purpose being a high grade mineral wool packed six inches deep at the top and three inches thick around the sides.

The advantage of the vacuum oil tube is that it becomes, in effect, the heating element and thus gives a heating surface many times greater than that of the average heating device. It can heat the water in less time at a lower unit area temperature. The heat of other devices is more concentrated and thus produces scale.

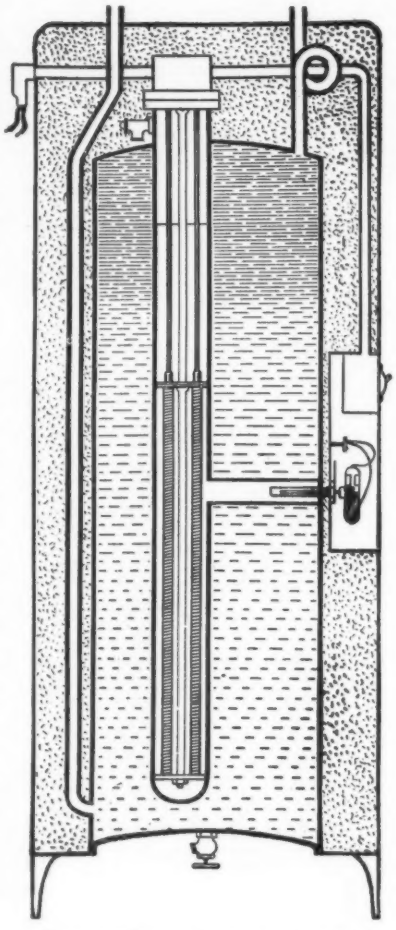
The Electromatic can be connected with any furnace or kitchen range hot-water circuit. Since it operates automatically, it will maintain the water at the desired temperature after the furnace or range heat has dropped too low to do the job.

Ants in Indian Surgery

THE use of "surgical ants" with powerful jaws to stitch the wounds of human beings, and other primitive medical practices developed by the Indians living far in the interior of Peru, are described in a report received recently at Field Museum of Natural History from the Marshal Field Botanical Expedition to the Amazon.

Llewelyn Williams, leader of the Peruvian division of the expedition, had just returned to Iquitos after a collecting trip along the Amazon and some of its tributaries which took him as far as the Brazilian border. Parts of the regions explored are believed never to have been entered by white men before.

"The natives of the equatorial forest show great originality and dexterity in the treatment of wounds and illness," writes Mr. Williams. "Trees, shrubs, and plants with medicinal properties are widely employed, and a surgical handicraft in which certain insects are used has been developed.



Cross-section of new electrical water heater; controller at right

"In the case of a gaping wound, a certain ant which has very powerful jaws is sought, and the ant is made to bite the severed edges of the cut skin and thus bring them into juxtaposition. In the operation the ant-surgeon loses its own life for after it has drawn the skin closed with its jaws, its body is snipped off, and the lifeless head remains with its death grip on the skin until the wound is healed. Sometimes these Indians are found with half a dozen of these ants' heads holding a large wound closed during the long healing process.

"After inter-tribal battles, in which fighting is done with axes and machetes or bush-knives, many of the warriors return home with deep, ghastly, and apparently fatal wounds. The women, however, are usually successful in treating these wounds. After bathing them, they apply ginger as a local anaesthetic. Then a plaster is made from the pulp of a weed known as 'Santa Maria,' and the wound is bandaged with a dried banana leaf. In a week or so most of the wounds heal. Sometimes the crushed body of a certain ant is applied as a salve. The injured men are placed on a diet eliminating salt and fats, and made to drink large quantities of an infusion prepared from the bark of a tree.

"Long thorns are sometimes used as surgeon's needles. The skin at one side of an open wound is pierced with the thorn, and it is then thrust across to and through the opposite skin edge, the protruding end of the thorn being fastened with string and left there until the two edges have fused.

"In the wet lowlands there is a female jigger or burrowing flea which buries itself in one's flesh. There its body swells and becomes globular, being distended with a huge quantity of tiny eggs. The natives remove this by working carefully around the insect's body with a needle. Skill is necessary to avoid breaking the egg sac, for if a single egg is left in the wound the operation is valueless.

"There is also a worm which burrows into the legs of its victims, forming a swelling like a boil which breaks, and then the worm protrudes its head. Any attempt to drag it out suddenly, fails, as it tears. The natives draw a few inches out carefully day by day, rolling the exposed end around a small piece of wood. Much delicate manipulation is required, as this entozoon ranges from six to ten feet in length."

Outboard Motor Becomes a Work Horse

AN outboard motor designed for pleasure outings became a work horse recently and helped to repair the ravages committed by Lake Michigan during the March storms. The pounding of the waves reduced the wooden breakwater in front of the Johnson Motor Company at Waukegan, Illinois, to kindling. When the storm subsided, the naked piling was left standing, unsightly and useless before the factory doors.

The factory manufactures outboard mo-

Removing piling with outboard-powered high-pressure pump

tors capable of producing from a fraction of a horsepower to more than 32 horsepower. The engineers commandeered a power head capable of producing about 10 horsepower and used this boat engine to remove the piling. Attached to a centrifugal pump, the motor threw a stream of water at high pressure for more than 50 feet.

A raft, the power head mounted in a boat, a length of hose, and iron pipe completed the equipment used by the crew of men to remove about 20 of the piles. The pipe was thrust into the bottom of the lake alongside the piling, and the thrust of the water at high pressure loosened the huge poles. They were then pulled out by the men on the raft and dragged to shore.

New Type of Rubber Blocks X Rays

RADIO fans who happen to be located near a hospital or any other place where an X-ray machine is operated, are painfully aware of the ease with which X rays penetrate ordinary walls. In order to insulate an X-ray apparatus, it has been necessary to line the walls of the room with heavy sheet lead. Now, however, rubber chemists have discovered that certain lead compounds can be incorporated with rubber to make an ideal shield for the vagrant X rays. The new material is known as Ray Rubber and has been successfully tried out in a hospital in New York City.

Ray Rubber contains a homogeneous lead compound which has passed all tests made by X-ray machine manufacturers. Dangerous X rays cannot penetrate Ray Rubber. It provides a good-looking surface easily kept clean, making the X-ray room attractive rather than dull and drab since the material is available in a variety of standard colors.

Ray Rubber replaces the old Holland barium brick, heavy and expensive because it had to be imported; barium mixed with plaster which cracked, permitting the rays to pass through; and lead, which requires expensive burners to perfect its joints. Ray Rubber has a peculiarly fashioned reverse curve edge which permits a small lap joint through which no X rays can pass.

It is easily applied with an approved type of cement to walls and floors, doing away with troublesome fastenings of various sorts. For the floors it may be applied either to concrete or wood. Edges of the flooring and joints are made impervious to ray penetration by application of Ray-proof cement.

Ray Rubber is made in blocks 18 by 24 inches and 0.5 inch thick, which has an equivalent screening power against X rays of 0.125 inch of lead.—*A. E. B.*

Blind Spots and Collisions

IT is an interesting fact that three important aeronautical publications, *Aviation* in the United States, *The Aeroplane* in England, and *L'Aéronautique* in France should discuss at about the same time the question of blind spots on the airplane and their effect in increasing the possibility of collisions.

In the early days of flying, when traffic was very slight, pushers with nacelles forward of the wings were quite common. An example of such design is the Farman F.40, which was quite famous during the World War. In this plane, both pilot and observer were seated so as to be practically clear of all obstructions to vision. The disadvantage of this type was the placing of the heavy engine behind the crew, and so it was gradually discarded. Yet from vision considerations, this type was well nigh perfect—or at any rate far superior to the airplane of today.

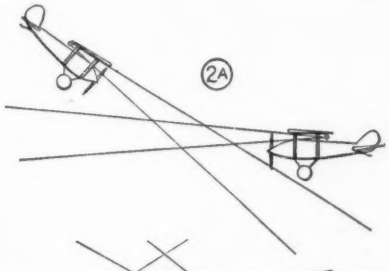
Monsieur Henri Bouché, Editor of *L'Aéronautique*, illustrates the collision dangers of the modern airplane in some graphic diagrams, which we reproduce in these columns. In one diagram is shown the "parasol" monoplane; that is, a monoplane with the wing placed at some height above the fuselage. The range of vision is indicated by the lines. When two parasol monoplanes meet they may readily strike head-on.

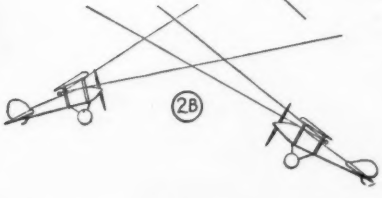
In another diagram, the upper machine, with enclosed cabin, may be struck by the parasol monoplane approaching it from below.

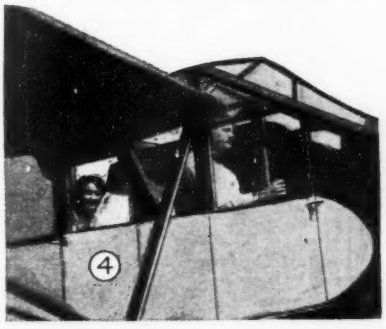
It is not difficult to imagine similar difficulties when machines are landing or taking off on a busy field.

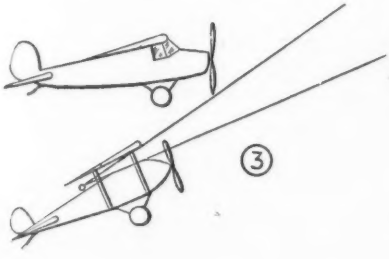
Two engineer-pilots, also writing in *L'Aéronautique*, suggest a number of remedies, some novel, some borrowed from the practice of other designers.

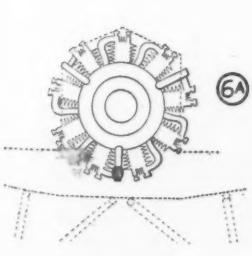
Suppose that the designer, for a variety of reasons, has decided to build a high-wing cabin monoplane. Then the pilot should be placed well forward, ahead of the wing, with the wing somewhere about the level of his eyes. The entire cabin should be provided with non-shatterable glass—ahead, above, at the sides, and below far toward the rear. The Berliner-Joyce cabin

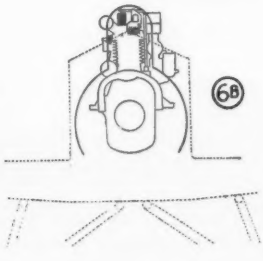


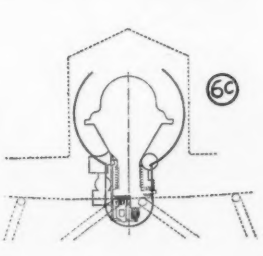


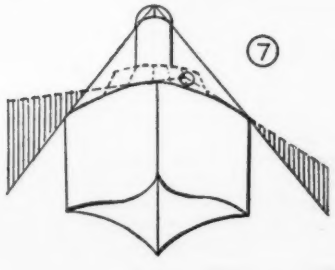












In the famous Farman war-time plane, *1*, the pusher nacelle made possible almost perfect vision. Parasol monoplanes, *2*, may collide head-on because of restricted area of sight. A parasol plane coming from below may get into difficulties as in *3*. The pilot's position in the Berliner-Joyce monoplane, *4*, affords an almost unobstructed view. The open cockpit, low-wing Aeromarine-Klemm monoplane is at *5*. A comparison of the obstructing qualities of engines is given in: *6A*, a radial; *6B*, a conventional in-line; and *6C*, an inverted in-line. A conning tower, *7*, has been suggested for flying boats

monoplane is an interesting illustration of this idea. Of course there is some sacrifice in efficiency because the line of fuselage and wing is broken, and this means increased drag.

A very promising design for commercial use is the low-wing monoplane, in which the pilot is placed either ahead of the wing or at its leading edge. Here the blind spots above and towards the rear disappear completely. The vision below is obstructed somewhat, but the imperfection of vision is far less than in the high-wing job.

Even if the low-wing monoplane is employed, the vision may not be perfect ahead. Improvement is to be sought by narrowing down the fuselage ahead of the pilot. This depends greatly on the choice of engine. In the sketch, a low-wing airplane is depicted with a radial air-cooled engine in one case, a four cylinder in-line air-cooled engine in the second case and an inverted air-cooled engine in the third case. It is remarkable what an improvement the inverted engine makes possible in vision forward, because the fuselage ahead of the pilot may be made narrow.

Another step in the direction of perfect vision, advocated by designers not only in Europe, but also in the United States, is the re-employment of the pusher, low-wing monoplane with outriggers supporting the tail. In the pusher monoplane, even if the nacelle is an enclosed cabin, the vision is perfect.

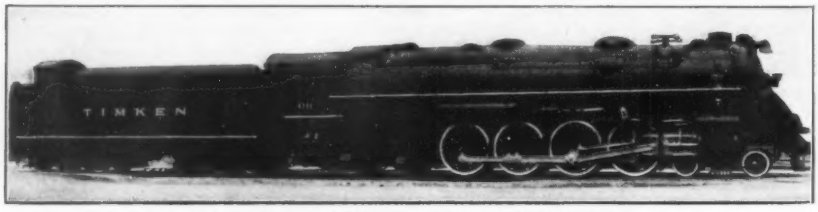
Airplane design moves in cycles and it would not be surprising to see the practice of 15 or more years ago revived in our most modern craft. The Northrop "flying wing" is a step in this direction.

Even in the very large flying boat the question of pilot's vision is not to be escaped. A pilot sitting fairly low in a wide flying-boat hull, may have excellent vision on one side and be seriously handicapped on the other. Is a species of conning tower worth while in spite of the extra head resistance involved?—*A. K.*

Roller-Bearing Demonstration Locomotive

NOT so long ago the prediction was made, during the course of a speech before a group of railroad men, that trains would soon be attaining a speed of 110 miles an hour. This probably seemed a rather sweeping statement, especially with regard to the time element implied. But, the appearance of a locomotive with a rated speed of 85 miles an hour gives the impression that fulfilment is not so very far away after all.

The history of this locomotive is short, but interesting; it was built by The Timken Roller Bearing Company, primarily as a means of obtaining complete and accurate data on the practicability and performance of tapered roller bearings in railroad service. The company plans to lend the locomotive to various railroads throughout the country for operation in their regular passenger and freight service for certain periods. During its stay on the different lines its performance will be closely observed, and a careful record will be kept of the expense necessary to maintain it. Thus a fund of information covering both the economic and practical phases of the bearing question will be accumulated.



A mobile rail laboratory for roller bearings

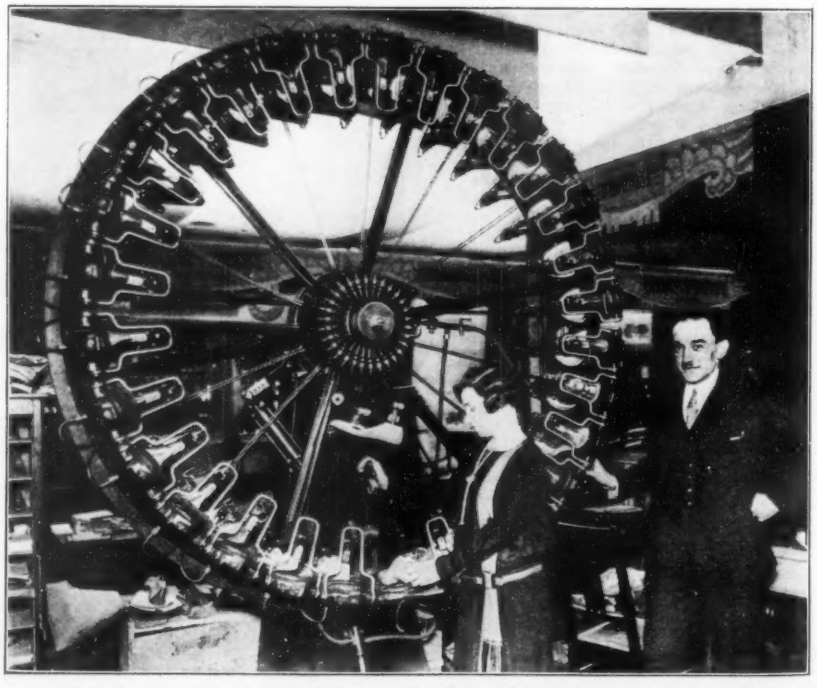
The very fact that it is intended for a mobile laboratory has led to the incorporation of features in design and construction that have resulted in making it something altogether unique in railroad history. Since it is to be used on both passenger and freight service, interchangeably, it had to combine the speed characteristics of a passenger locomotive with the pulling power of a modern high-speed freight locomotive. As different railroads have different limitations as to permissible weight on the drivers, or axle load limitations, provision had to be made for altering the weight to meet these requirements. And, in addition to the tapered roller bearings, it offered an opportunity to experiment with various alloy steels as material for parts ordinarily subject to excessive wear or strain.

The locomotive was built by the American Locomotive Company, according to specifications furnished by the Timken Roller Bearing Company. It is of the 4-8-4 type, is 102 feet long over all, and has a total weight of approximately 710,000 pounds. The engine proper weighs 417,000 pounds. It is built to operate at two steam pressures, 250 pounds and 235 pounds respectively, and is provided with a duplex weight distribution so that the weight on the drivers may be either 264,000 or 246,000 pounds. The first is used at 250 pounds steam pressure to give a normal tractive effort of 63,700 pounds which is increased by the booster to 76,500 pounds maximum at starting. At 235 pounds pressure, the normal tractive effort is 59,900 pounds, and the maximum at starting is 71,900. This arrangement takes care of the varying limitations on different railroads. The specifications call for a maximum speed of 85 miles per hour, with a dynamic augment within the limitations usually specified for similar locomotives at diameter speeds. Actually, the construction is such that this speed can be exceeded without passing the limitations as to dynamic augment.

Heredity

IT has, in general, been taken for granted that human heredity is fixed and that new characters can be developed only by accident, sports, or by the passing of thousands of years. Recently Professor Erwin Baur discussed in Germany the possibility of modifying characters by the use of chemical and physical stimulation. Research carried out on flies and on plants has shown hat it is possible to bring about changes through modification of some part of the chromosomes.

American investigators found that the action of radium would change the nucleus of the cell. Baur produced changes in plants by modifying the structure not only of the nucleus but also of the protoplasm of the cell. When plants were subjected to immersion in hot or cold solutions or to the effects of various drugs, such as chloral, ether, or alcohol, they continued to develop and propagate and the succeeding genera-



Greatly increased production is promised by this ingenious shoe-making machine recently developed in England. With it, it is stated, it is possible to turn out 600 completely finished pairs of shoes in eight working hours

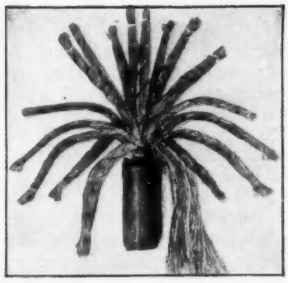
In fair weather or foul . . .

Western Electric backs up your telephone service

In foul weather, just as in fair, Western Electric backs up the Bell System with all the apparatus and supplies needed to restore, maintain or expand your telephone service.

This Company manufactures telephone equipment of every sort, with a skill acquired through 50 years' experience. At 32 warehouses it holds great reserves of telephone material available for shipment day or night. It delivers and installs the apparatus when and where needed.

The large scale manufacture of standardized equipment, too, is an economy. So is the concentrated purchasing—a responsibility that Western Electric undertakes for the telephone companies of the Bell System. All in all, here is a work of mass production, purchasing and distribution which for size and complexity has no parallel in industry.



1818 conversations at one time can be carried on through this new type cable. It contains 3636 insulated wires within a diameter of 2⅝ ins.

The flying telephone laboratory in which Western Electric airplane telephone equipment has been developed by the Bell Laboratories. Provision for communication between ground and plane marks a great forward step in flying.

One of the 18 materials in your telephone is rubber from the plantations of Sumatra. Western Electric goes to market in every corner of the world.

Western Electric

THE MAKERS OF BELL TELEPHONES

tion did not show any change. However, in the third generation dwarfism, degenerations, and bent leaves and blossoms, appeared. Thus it is obvious that factors affecting the human cell may actually have their influence not only to the third generation but primarily in the third generation.

Before a German society for the advancement of science, Prof. Ernst Rüdin announced the fact that several of the children of people with hereditary chorea developed chorea at an early age. Among the children of people with manic-depressive insanity, 33 percent of the children are affected; among the children of epileptics, 10 percent are affected; and among the children of parents with hysteria, 13 percent are affected. The mental health of the child is clearly the reflection of the mental health of its parents. Notwithstanding the fact that this inheritance is clearly established, persons continue to marry without any attempt at investigation of their antecedents from the mental point of view and without any realization that the offspring are bound to reveal the effects of the mentally weak heredity.—*M.F.*

A Plane Price War

THE Stinson Aircraft Corporation, recently acquired by the Cord automobile interests, threw a bombshell into aviation circles, at the time of the St. Louis show, by announcing some startling price cuts. Our photograph shows the Stinson four-place cabin plane, powered with a 210 horsepower Lycoming radial air-cooled engine. The plane is of neat though conventional design, and has excellent performance and flying characteristics.

The airplane builders are now rivaling the automobile builders in the completeness and luxury of equipment. The Stinson has an electric self-starter, adjustable metal propeller, wheel and emergency parking brakes, cabin heaters, hydraulic and spring shock absorbers, broadcloth upholstery, shatter-proof glass, rubber-insulated motor mount, gasoline gages, dual wheel control, adjustable pilot seats, balloon tail wheel, navigation lights, and smoking sets.

Last year planes of this type were selling at about 9000 dollars. Now the Stinson company announces a price of 5775 dollars. In some aviation circles the opinion is held that the Stinson Company will lose money rapidly. Others hold that increased sales and better production will justify the reduction in price and that eventually a plane of high finish and performance will sell to the private owner at prices no higher than those of a really first-class automobile.—*A.K.*

A four-place Stinson Junior cabin plane that sells now for only 5775 dollars, a price far lower, for this particular type of plane, than ever before quoted

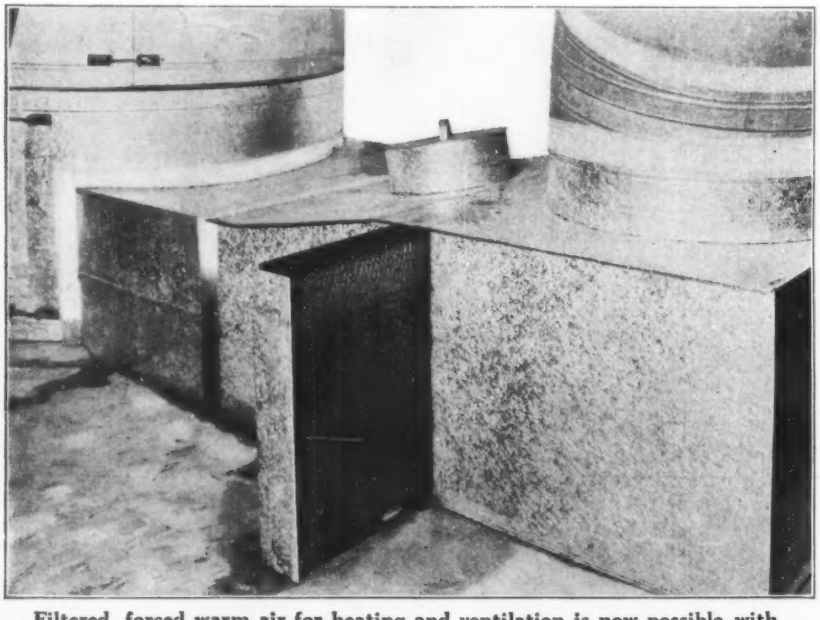
Fever and Radio Waves

FEVER is the reaction of the body to disease. Heat developed in the body helps to control germ activity. In the attack on general paralysis by the malaria injection method, one of the results of the injection is to produce fever. In the treatment of other conditions like general paralysis the production of fever may be an important factor. Fever in the human being follows the injection of any foreign protein substance. When such injections are made, their actions are sometimes severe.

Attempts have been made by the workers in the Research Laboratories of the General Electric Company to develop some system of raising the temperature of the body without injecting anything into the body. Drs. C. M. Carpenter and A. B. Page have been developing a method of raising the temperature by the use of short wavelengths. In this method the energy is concentrated between two condenser plates made of aluminum covered with hard rubber to prevent arcing should the patient or any attendant come in contact with the plates. The person whose temperature is to be raised is suspended on cotton tapes stretched across a wooden frame and surrounded with Celotex so that there is a fairly tight air chamber around the body. The plates are placed at each side of the Celotex box and the waves oscillate through the body from one side to the other.

It has been possible to raise the temperature of a man five degrees in one hour with this apparatus. Indeed, it would be possible to raise the temperature much higher than 104 to 105 degrees, but this has not been done because of the possible danger.

When the temperature of the body is raised rapidly by such a device, the person begins to have a fast pulse and to breathe more rapidly. Usually the blood pressure falls. In some instances high temperatures were maintained for one hour without apparent distress or fatigue to the patient. It is believed that the development of the heat in the body is due to the resistance made by the body to the conduction of the current. The evidence thus far available from studies in some 25 human beings and of many laboratory animals indicates that the heat within the body makes it less favorable for the multiplication of germs and that the increased rate of the various chemical processes in the body aids the resistance to disease and infectious agents. —*M.F.*



Filtered, forced warm air for heating and ventilation is now possible with this combination of filter, shown here partly withdrawn from its housing, and electrically driven fan. The fan draws cold air through the filter for cleaning, and delivers it to an ordinary hot-air furnace for heating

Welding Copper Made Easy

UNTIL recent years it was considered that the satisfactory welding of copper was impossible. The high thermal conductivity of the metal gave rise to grave practical difficulties, and even if these were overcome it was found that the copper became brittle by the action of the gases in the acetylene flame. As the result of recent research work, however, a process for welding copper has now been evolved which renders the operation simple and safe, provided the correct materials are used.

A demonstration of this welding was carried out recently at Swansea, England. At this demonstration copper pipes were welded together without difficulty and the joint subjected to severe flattening and bending tests, the results of which proved conclusively that the weld would withstand

conditions of service as satisfactorily as the pipe itself. Sheets of copper were also joined together by the welding process, and it was shown that these would withstand a considerable amount of work and stretching; in fact, as much as the solid copper itself could be expected to withstand. The welding of varnish-pot seams was also demonstrated, a process which eliminated a great deal of troublesome riveting. It was observed that the welding operator worked quickly and as easily as if he were merely brazing the pieces together, and after the weld had been made and trimmed it was difficult to see where the joint occurred, while it had a tensile strength equal to that of rolled copper.

The demonstration proved that the difficulties previously associated with the welding of copper had been overcome, and it is certain that there is a wide field in industry for the application of the process. Riveting will be largely eliminated, and vessels which previously had to be forged out of solid copper—a very expensive procedure—can now be built up by welding sections together. All this has been achieved by means of slight modifications in the technique of welding ferrous metals, by the use of copper alloy filler rod and flux of the appropriate type.

The copper that has been developed for welding purposes is not attacked by the gases of the acetylene flame, and it is essential to use this copper if the weld is to be perfectly satisfactory. The copper is a modification of the tough pitch variety, supplied at the same price, but not inferior to it in any way; in fact, it might be expected to give better service generally. The filler rod, again, is of specially modified copper, which is very fluid when molten, and so runs well into the joint, leaving no air locks or gaps. It is essential to use this filler rod in order to obtain a homogeneous weld. The flux is used in order to hinder the formation of scale on the red hot copper as the scale prevents good metallic contact, and hence a solid joint, from being obtained.

Using these materials, it was demonstrated that with an hour's practice a welder could acquire the technique of copper welding and produce sound joints as easily as he could with ferrous materials. —*A. E. B.*

Regulating Air Transport Services

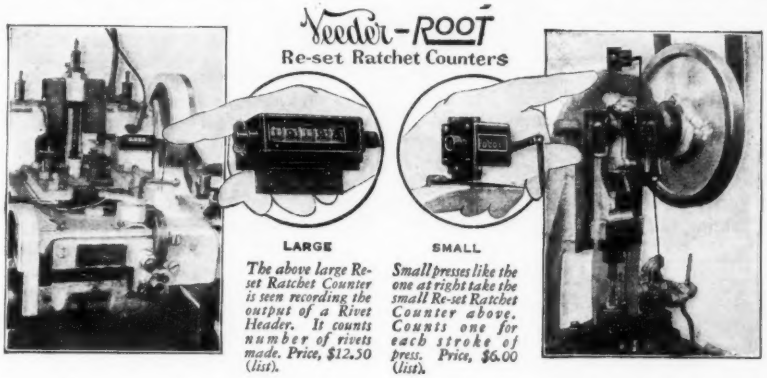
IN the continued depression of the aviation industry, there is one bright spot—the continued and rapid growth of the transport service; mail, passenger, and (to some extent) express.

We believe that the new regulations of the Department of Commerce regarding transport services will help rather than hinder this growth. These regulations provide that before scheduled operation of passenger air transport is established, a Certificate of Authority must be obtained from the Secretary of Commerce. To secure and retain such a certificate the service must provide satisfactory aircraft and equipment, an adequate number of qualified airmen, a high degree of maintenance efficiency, good airways and navigation facilities, and a first-class ground organization.

Nothing is so well calculated to inspire the traveling public with confidence as regulations of this character, well and diligently administered.—*A. K.*

Machines Pay Counter-Bills Promptly

Veeder-Root
Re-set Ratchet Counters



LARGE

The above large Re-set Ratchet Counter is seen recording the output of a Rivet Header. It counts number of rivets made. Price, $12.50 (list).

SMALL

Small presses like the one at right take the small Re-set Ratchet Counter above. Counts one for each stroke of press. Price, $6.00 (list).

Where rate of production has any relation to rate of profit, use *Counters* with no thought of *cost*. They'll give an accounting for every unit of output; every ounce of material; every hour of labor-cost.

What you *save* on all these items quickly "writes off" the Counters. Your machines pay the bill automatically—in YIELD. Costs you only a moment's thought to realize how they'll economize on production-costs.

Your request brings Catalogue of the Counters needed.

Veeder-Root INCORPORATED HARTFORD, CONN.

OFFICES IN PRINCIPAL CITIES; WRITE OR PHONE

MUNN & CO.

PATENT ATTORNEYS

SCIENTIFIC AMERICAN BUILDING

24-26 WEST 40TH STREET, NEW YORK CITY

1319 F ST., N. W.
WASHINGTON, D. C.

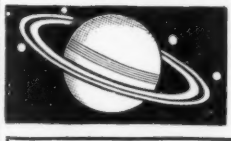
6 NORTH MICHIGAN AVE.
CHICAGO, ILL.

714 SOUTH HILL ST.
LOS ANGELES, CAL.

582 MARKET ST.
SAN FRANCISCO, CAL.

BOILER FEED WATER TREATMENTS
of purity and all other required characteristics.
Pamphlet on request
SIME, DARBY & CO., Singapore, S. S.
Agents for Straits Settlements.
UNISOL MFG. CO., Jersey City, N.J., U. S.A.

AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago



ASTRONOMICAL
TELESCOPES
Send for Catalog
WM. MOGEY & SONS Inc.
PLAINFIELD, N. J.,

1 of 21
Sizes and types of Hand and Motor Operated Cold Pipe Bending Machines we make bending 1/4" to 8" Pipe.
Lead the World in Sales and Performance.
Cost of Bending
1"—3 cents 3"—20 cents 6"—60 cents
2"—5 cents 4"—40 cents 8"—$1.00
American and Foreign Patents
Over 8,000 in use. Send for Printed Matter and Prices
AMERICAN PIPE BENDING MACHINE CO., Inc.
32 Pearl Street, Boston, Mass.

Glider History No. 2:

"On June 6th, 1930, at Rockford, Illinois, the 'Rhon Ranger' floated aloft over level ground for seventy-five seconds from an altitude of only 250 ft."
For particulars about this supreme Training Glider—the Construction Kit at $89.50—the Partly Assembled Kit at $129.—the Completed Ship at $395.00—send 10c to
MEAD GLIDERS
Dept. J. 12 S. Market St. Chicago, Ill.

The Amateur Astronomer

Conducted by ALBERT G. INGALLS

WORD comes out of the wilds of Vermont that the fifth annual "get-together" of amateur telescope makers will be held on August 15, 16, 17 at the usual place, "Stellafane," near Springfield. Let this notice serve as sufficient excuse for all and sundry to come. John Pierce and the

Bob Burns. He saved 80 "bob"

other members of the "Telescope Makers of Springfield" expect later to send out individual postcard announcements to those in the east, but do not let failure to receive one keep you away; it might be merely a mistake. "The big day," Pierce writes, "is Saturday, the 16th, with Porter, Redfield, Marshall and other illustrious people strutting their stuff." We do not know what profound secrets these entertainers have up their sleeve. Mr. Redfield's specialties are cornbread and poetry.

Last year so many attended this informal confab of amateur telescope makers and astronomers that it was a question whether to rent a circus tent next time. People came from all over the east, and some from greater distances, to commune with other enthusiastic telescope fans. There is a small hotel in Springfield, also very limited "quarters" (for men) at "Stellafane." A good many come in their cars, bringing their families and tents. There is all sorts of room to camp, and a good spring of water is nearby. Leave your dress suits in mothballs, as this is not a "high hat" affair but just a friendly, comfortable gathering of "folks." If you have made a telescope or invented any kind of optical dingbat of which you are unashamed, bring it along and give the other fans a chance to knock it. If you wish to make any special arrangements write to the Secretary of the "Telescope Makers of Springfield," Oscar S. Marshall, 135 Wall Street, Springfield, Vermont.

WHEN the hot months come people usually let up their efforts in telescope making; they had rather be out of doors than working in the cellar workshop. About September the orders for the instruction book "Amateur Telescope Making" always begin to come in thick and fast, and then we know the game is on again. However, to judge from the postcard announcement which is reproduced on this page, telescope making activities never wane, even in hot weather, in lively Los Angeles. Fragments of information reach us from time to time about the various activities of the Amateur Telescope Maker's Society of Los Angeles, the latest being that they have gone in heavily for refractor making. The seed that was dropped in that city four years ago is growing—in fact, already has grown—into a thriving tree. We wish the amateurs of "L. A." would send in accounts of their doings, with photographs of the jobs done, for publication.

Some of the telescopes made by amateurs have been pretty elaborate affairs and some are not so elaborate. However,

Los Angeles, Calif., June 7, 1930.

DEAR SIR:

The next regular meeting of the Amateur Telescope Maker's Society will be held in the History Seminar room of the Public Library, 5th and Hope Sts., Thursday June 12, at 8 P. M.

Mr. Donald Perry one of our junior members, will be the speaker of the evening. He will demonstrate a spectroscope, from A to Z, the product of his own hands and brain.

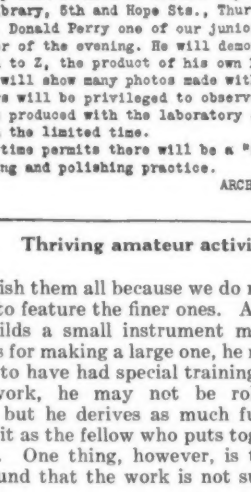
He will show many photos made with the instrument, and the members will be privileged to observe those spectra which can be produced with the laboratory equipment available, and within the limited time.

If time permits there will be a "question box" on standard grinding and polishing practice.

ARCHIE M. NEWTON, Secretary,
2651 West Ninth St.

Thriving amateur activities in "L. A."

we publish them all because we do not wish merely to feature the finer ones. A worker who builds a small instrument may lack facilities for making a large one, he may not happen to have had special training in machine work, he may not be rolling in wealth, but he derives as much fun from making it as the fellow who puts together a big one. One thing, however, is that we have found that the work is not suited to boys. Very few have made good at it, and those, we suspect, were unusually bright lads with an aptitude for mechanical work and for thinking.

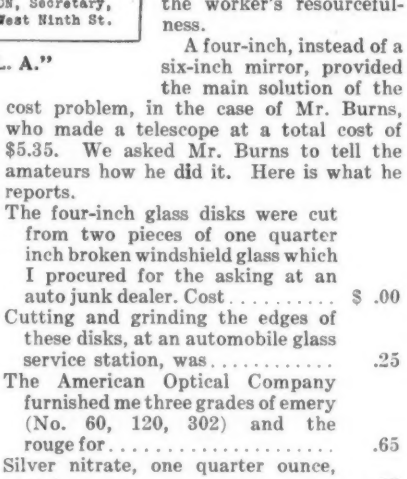


***Above and at right,* "Friday" Angier's unique design**

JUST how inexpensively a telescope can be made never has been settled, but Bob Burns, of 326 Courtland N. E., Atlanta, Georgia, has shaved a big chunk off the average cost of a six-inch reflector. The materials for a six-inch telescope which will magnify from 50 to 200 diameters usually cost about 25 dollars. The initial outlay is ten dollars for a prepared package containing the glass disks, abrasives, and pitch. With these the mirror is made and then after some time the eyepiece and diagonal prism, each at six dollars, are obtained. The average amateur worker can be trusted to pick up the remaining parts, chiefly secondhand, for little or no more than the remaining three dollars. Often we are asked whether there is a way to make a telescope still more cheaply than this. There is. If one can pick up a microscope eyepiece this will save six dollars. Other savings are possible in some cases, depending on the worker's resourcefulness.

A four-inch, instead of a six-inch mirror, provided the main solution of the cost problem, in the case of Mr. Burns, who made a telescope at a total cost of $5.35. We asked Mr. Burns to tell the amateurs how he did it. Here is what he reports.

The four-inch glass disks were cut from two pieces of one quarter inch broken windshield glass which I procured for the asking at an auto junk dealer. Cost	$ .00
Cutting and grinding the edges of these disks, at an automobile glass service station, was	.25
The American Optical Company furnished me three grades of emery (No. 60, 120, 302) and the rouge for	.65
Silver nitrate, one quarter ounce, cost	.25



I used household ammonia and formaldehyde to reduce the silver nitrate, when silvering the mirror. Cost to me	.00
A wood turning shop made the wooden mirror cell for	.50
The 24-inch tube is made of polished sheet zinc, and cost	.90
For my diagonal I used a piece of one quarter inch plate glass of oblong shape, 1¼ by ¾ inches, corners rounded, the supports being soldered to the inside of the tube. The cost of this was	.00
The eyepiece was taken from a "pencil" microscope which cost	1.00
Brass tubes for eyepiece (plumber's shop)	.15
Lumber for tripod, cut to size	1.25
Bolts for tripod	.20
Lacquer and brush for painting tripod and inside of tube	.20
The total expenditure came to	$5.35

I polished my mirror by gluing the crown of an old felt hat to my tool and polishing on this pad. It finished out in about 1½ hours. I made no attempt to change the curve from a sphere to a parabola.

With the three quarter inch, double-convex eye lens the telescope gives about 50 to 60 diameters magnification. The innumerable craters on the moon are very interesting

PHIL E. CHURCH, 104 East LaRue, Streator, Illinois, sends in a few pictures of an unusual telescope. He says: "Three of us did the work, but 'Friday' Angier conceived and built the mounting. The steering wheel is for rapid control in directing the telescope but there are slow-motion screws and these are turned by means of sewing machine flywheels. The three of us, 'Friday,' Herbert Prafcke, and I, are greatly satisfied with this arrangement and we invite comment from other amateurs." Are there any who want to break a lance with these three musketeers?

THE following hint is from the April number of the *Journal of the British Astronomical Association* and was contributed by Walter E. T. Hartley, 11 Manor Road, Edgbaston, Brimingham, England. Birmingham is one of the great industrial centers of Great Britain and much bitumonious coal, with its inevitable content of sulfur which quickly tarnishes silver, is used. He says, "I keep two layers of cotton wool in the cover, and while observing put the cover in front of the fire—this ensures a dry film, but I have now between the wool and the mirror two thicknesses of blotting paper which have been soaked in a strong solution of lead acetate and then dried. As a result my last silvering was done in 1923, and the mirror is only now beginning to show signs of tarnish." Try it, someone, and see how it works, for soft coal sulfur in America is the same as soft coal sulfur in England.

HERE is an interesting hint. Harold A. Lower, 1032 Pennsylvania Avenue, San Diego, California, who is always trying out something new in amateur optics, writes: "I discovered a new use for a microscope the other day. The mechanical stage makes an excellent arrangement for controlling the knife-edge when making the Foucault test. Just attach the razor blade to the mechanical stage by means of a small D-clamp, and it works as if made to order."

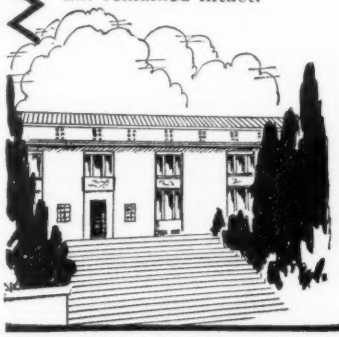
Science

of Today, Determines Tomorrow's Civilization

You'll enjoy it's short snappy bits of news from leading scientists, at the same time the accuracy has remained intact.

For a few cents weekly you can have a publication that gives a delightful description of scientific happenings, weeks in advance of other magazines. Be prepared to discuss any scientific issue.

Subscribe for the



SCIENCE NEWS-LETTER

Yearly Subscription $5

13 weeks for $1 26 weeks for $2

SCIENCE SERVICE

2183—B Street, N. W.

Washington, D. C.

25 POWER $1

GERMAN POCKET MICROSCOPE

A marvelous German 25 power microscope, size of pencil. Enlarges diameter 25 times, area 625 times. Fine lenses give extra large field and great light. Only 4 3/8 inches x 3/8 inch; weighs but ½ ounce. Used in schools and colleges thruout the country. Fine for biology, geology, botany, nature study, examining stamps, finger prints, insects, cloth, metals, photographs and thousands of other things. Equipt with handy fountain pen clip.

$1 Prepaid. Money back guarantee. Discount for 6 or more.

BINOCULARS Over 200 Glasses. All Makes—$1-$110

Everything in binoculars, field glasses, telescopes and optical instruments. The finest and largest assortment in America. Catalog gives all information how to choose the best for your individual needs at the LOWEST PRICE.

Try America's Leading Binocular House First

DuMaurier Co., Dept. 168, Elmira, N. Y.

IMMEDIATE DELIVERY

Bond STANDARD STOCK GEARS

Nationally Distributed

Ask for Catalog No. 54-S

CHARLES Bond COMPANY 617 ARCH ST., PHILADELPHIA, PA.

GEARS

In Stock—Immediate Delivery

Gears, speed reducers, sprockets, thrust bearings, flexible couplings, pulleys, etc. A complete line is carried in our Chicago stock. Can also quote on special gears of any kind. Send us your blue prints and inquiries.

Write for Catalog No. 20

CHICAGO GEAR WORKS

769-773 W. Jackson Blvd., CHICAGO, Ill.

CHEMISTS

Catalog illustrating 2500 Chemist's Supplies, 5000 Chemicals, Minerals, Drugs, etc., and listing 1000 Scientific Books sent for 50c. Glass Still, as illus. cap. of flask 1 Qt. complete $8.

LABORATORY MATERIALS CO.

637 East 71st Street, Chicago.

PRATT INSTITUTE

Brooklyn, N. Y.

School of Science and Technology

Industrial Mechanical Engineering
Industrial Electrical Engineering
Industrial Chemical Engineering

Intensive TWO-YEAR Courses

Descriptive Circular on Request

Scott's Creeping Bent for Perfect Lawns!

Sod in six weeks. A rich, velvety stretch of lawn that chokes out weeds before they can grow! A deep, thick, uniform turf that's everlasting and that makes your home a beauty spot.

The New Super-Lawn

Instead of sowing seed, you plant stolons or the chopped grass—and in a few weeks you have a luxuriant lawn like the deep green pile of a Turkish carpet. Read all about this unusual grass in our illustrated booklet "Bent Lawns." Mailed on request. Fall is the best time to plant.

O. M. SCOTT & SONS CO.
196 Main Street, Marysville, Ohio

Another Scientific "Best Seller"

FLOYD L. DARROW'S

The New World of Physical Discovery

Covers the whole of physics, both old and new, in the author's most intriguing style, for a wide audience who want instruction and interest with brightness of touch. A "Scientific Book Club" selection. You are bound to enthuse over it.

$3.70 *postpaid*

Scientific American

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

LONGLEAF PINE PRIMER (Farmer's Bulletin No. 1486, U. S. Department of Agriculture) by W. R. Mattoon, describes the growing of longleaf pine as a crop, pine timber being so scarce. The pamphlet is fully illustrated. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

PORCUPINE CONTROL IN THE WESTERN STATES (Leaflet No. 60, U. S. Department of Agriculture) by Ira N. Gabrielson and E. E. Horn deals with a pest, for they girdle trees and injure forests. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

PROPERTIES OF SOILS WHICH INFLUENCE SOIL EROSION (Technical Bulletin No. 178, U. S. Department of Agriculture) by H. E. Middleton gives valuable light on an old problem. *Superintendent of Documents Washington, D. C.—5 cents (coin).*

THE COFEE INDUSTRY IN BRAZIL (Trade Promotion Service No. 92, U. S. Department of Commerce). *Superintendent of Documents.—20 cents (coin or money order).*

BISMUTH (Circular of the Bureau of Standards, No. 382, U. S. Department of Commerce) gives very full information on the metal and its alloys. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

GEOLOGY AND OIL RESOURCES ALONG THE SOUTHERN BORDER OF SAN JOAQUIN VALLEY. (Bulletin 812 D, Geological Survey, Department of the Interior) by H. W. Hoots. *Superintendent of Documents, Washington, D. C.—50 cents (money order).*

BREEDING TOBACCO FOR RESISTANCE TO THIELAVIA ROOT ROT (Technical Bulletin No. 175, U. S. Department of Agriculture), by James Johnson, is a study of a common and important disease of tobacco. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

NEW BRUNSWICK, CANADA, by L. O. Thomas, describes the industries, agricultures, natural resources, and development of New Brunswick. *Address the Director, National Development Bureau, Department of the Interior, Ottawa, Canada.—Gratis.*

GERMAN CHEMICAL DEVELOPMENTS IN 1929 (Trade Information Bulletin No. 690, U. S. Department of Commerce) reports the important events in the industry during 1929. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE NORTH WEST TERRITORIES 1930 is the title of an attractively illustrated handbook of 137 pages. A concise compendium of general facts relating to Northern Canada, it is accompanied by a beautiful map. *Address the Director, North West Territories and Yukon Branch, Department of the Interior, Ottawa, Canada.—Gratis.*

TIDES AND CURRENTS IN CHESAPEAKE BAY AND TRIBUTARIES (Special Publication No. 162, Coast and Geodetic Survey, Department of Commerce) by F. J. Haight, H. E. Finnegan, and G. L. Anderson, contains many folded maps. *Superintendent of Documents, Washington, D. C.—65 cents (money order).*

THE MARKETING OF NICKEL (Trade Information Bulletin No. 685, U. S. Department of Commerce) by J. W. Furness tells what nickel is, where it is produced, for what it is used, and where it is marketed. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

TIN IN 1928 (Excerpt pages 321-346 of the Mineral Resources of the United States, Bureau of Mines, U. S. Department of Commerce) by Charles White Merrill. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

PRELIMINARY REPORTS OF THE AERIAL MINERAL EXPLORATION OF NORTHERN CANADA gives an interesting account of investigation of large areas with the aid of airplanes. *Address the Director, North West Territories and Yukon Branch, Department of the Interior, Ottawa, Canada.—Gratis.*

WATER-POWER RESOURCES OF THE UMPQUA RIVER AND ITS TRIBUTARIES, OREGON (Water Supply Paper 636-F, Geological Survey, Department of the Interior) by Benjamin E. Jones and Harold T. Stearns. *Superintendent of Documents, Washington, D. C.—40 cents (money order).*

GEOLOGY AND COAL RESOURCES OF THE MEEKER QUADRANGLE, MOFFAT, AND RIO BLANCO COUNTIES, COLORADO (Geological Survey Bulletin 812-C, Department of the Interior) by E. T. Hancock and J. B. Eby. *Superintendent of Documents, Washington, D. C.—30 cents (money order).*

ULTRA-VIOLET REFLECTING POWER OF ALUMINUM AND SEVERAL OTHER METALS (Bureau of Standards Reprints, No. R.P. 141) by W. W. Coblentz and R. Stair. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

HOW TO BUILD HOME RADIOVISION EQUIPMENT explains the technique of radiovision reception and what is required by way of equipment, and then goes on to describe the construction of a practical radiovisor made from a kit of parts now on the market. *Jenkins Television Corporation, 370 Claremont Ave., Jersey City, N. J.—Gratis.*

AN ELECTRICAL METHOD FOR THE DETERMINATION OF THE DEW-POINT OF FLUE GASES (Circular No. 20. Engineering Experiment Station, University of Illinois) by *Henry Fraser Johnstone, University of Illinois, Urbana, Ill.—15 cents.*

STANDARDS YEAR BOOK 1930 (Miscellaneous Publications No. M 106) is a cloth-bound book of 301 pages. *Superintendent of Documents, Washington, D. C.—75 cents (money order).*

NATION BUILDING AND BEYOND (The Richard Cobden Lecture given at the Royal Society of Arts, London, May 7, 1930) by Nicholas Murray Butler is a very famous lecture which made a great sensation both here and abroad. *Carnegie Endowment for International Peace, 405 W. 117th St., New York City, N. Y.—Gratis.*

THE KYOTO CONFERENCE OF THE INSTITUTE OF PACIFIC RELATIONS (No. 260 of International Conciliation, May, 1930) by Chester H. Rowell. *Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass.—5 cents.*

WEIGHTS AND MEASURES REFERENCES (Miscellaneous Publications No. M 103) including an index to the reports of the National Conference on Weights and Measures, from the first to the twenty-first inclusive. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE COMMERCIAL STANDARDS SERVICE AND ITS VALUE TO BUSINESS (Commercial Standard CSo-30, Bureau of Standards, U. S. Department of Commerce) gives the whole idea in a nutshell and is an exceedingly valuable little pamphlet. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

TRAILSIDE CONVERSATIONS. PARTS ONE AND TWO (New School Series Number Four) by Wm. H. Carr. Describes the nature trails and trailside museum at Bear Mountain, New York. It is beautifully illustrated. *American Museum of Natural History, 77th Street and Central Park West, New York City.—20 cents.*

Our Point of View

Navies and World Problems

(*Continued from page* 93)

tration and the delegation had frankly said it was the best treaty obtainable under the circumstances. President Hoover was in no way responsible for our present inferior position in cruisers and submarines, nor for the unwillingness of Japan to reduce her tonnage *already built* to the 5 to 3 ratio.

The country is under obligation to Senators Hale, Johnson, and Robinson of Indiana, for the severe scrutiny they have given the draft of the treaty. They uncovered an ambiguity in the wording about cruiser replacement that might have caused serious misunderstanding; this was cleared up by an exchange of notes between the contracting parties. More important still, the answers to their persistent questions have more fully informed the public about the effects of the treaty.

The group of admirals led by Rear Admiral Hilary P. Jones, who analyzed the treaty, who showed the extreme concessions made to Japan, and who bore strong testimony to the value of 8-inch gun cruisers, deserve well of their countrymen. Called by the Senate committees, they were obliged to bear true witness to their beliefs; and though we support the treaty, we have no doubt of their sincerity or sound judgment. We believe with them, that 8-inch gun cruisers would better serve our purpose; but can't believe that 6-inch gun cruisers will not serve us well in any war that we might be drawn into. Important political factors have to be considered as well as naval, and with those in mind, we reluctantly conclude that our best hope for a navy within the next five years is to ratify the treaty and commence to build ships, instead of indulging in more conferences.

INSTEAD of frightening tax payers by talking about an 800,000,000-dollar program that will be spread over 8 to 10 years, the Administration should explain that the appropriation for this program will be about 90,000,000 dollars a year or about 75 cents per capita annually, a paltry sum for the protection it affords our country and its sea-borne trade.

A disquieting fact disclosed by the Senate testimony is the scant heed paid by the delegation to their naval advisers—apparently even Admiral Pratt was consulted only after the decisions were made by the delegation. There is a current opinion in the United States that in the past too little attention has been paid by the State Department to Army or Navy advice. The results of this rather disdainful attitude of the State Department is expressed loosely by the phrase heard in so many places "We never lost a war, and never won a conference." The country believed that Mr. Hoover, himself an expert engineer, would insist that the naval experts he attached to the delegation be consulted; Mr. Stimson almost airily relegated them to the rear. Democratic government is essentially a government by amateurs. Americans would not have it otherwise, but they believe Admiral Jones is more apt to be right on a naval problem than Secretary Stimson, and we think we would have had a better treaty if Stimson, Dawes, and Reed had not been a little over-eager to play it alone.

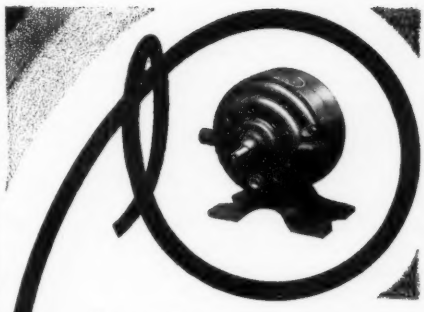
Fortunately, the life of this treaty is less than six years; then the whole question of ratios will be subject to reconsideration. If our people really want a navy and are willing to pay the small premium required for their naval insurance, they can build up to the treaty limits by 1936, and enter the next conference in a position to insist that our naval necessities be recognized. If we do not want a navy badly enough to pay for it, we should cease demanding that more prudent powers stop their building programs simply because we are too niggardly to build a navy that we all know we need, and need badly.

We should realize that, now having outbuilt us, Japan is unwilling to make the concessions that we made in 1922, when our ship-building program was about to give us sea supremacy. If our people appreciate the significance of this fact, and lose some of their naive belief in the altruism of other States, eventually they will be well compensated for the temporary disadvantage of the treaty.

ITALY and France are no nearer agreement than they were in London and it is quite possible that England may have to invoke the "safety clause" which allows an increase in her cruiser strength in the event that Italy and France enlarge their naval programs. We would be permitted the same increase granted England. Much more alarming than an increase in the Latin navies is the apparently irreconciliable rivalries of these two Mediterranean powers. Observers, who are usually well informed, speak in measured terms of the possibility of war between these two neighbors. Such a conflict would be bound to spread to other European States, and no one could predict its limits.

This is an uneasy period for Premier MacDonald. The unrest in India continues unabated and if this passive resistance extends as urged by Gandhi's successors, to a refusal by the great mass of Indians to pay taxes, the task of the Viceroy, Lord Irwin, will be difficult indeed. To add to MacDonald's troubles with Egypt and India, the small but strategically important island of Malta took occasion to flare up, and it is reported that considerable discontent with British rule exists within its limited confines. Unquestionably both India and Egypt have benefited by English rule; it is certain that neither could maintain law and order at home or resist foreign States unless supported by Great Britain; and yet, led by sincere but uninformed reformers, they continue their agitation for independence without any let-up.

It is one of life's fine ironies that the Labor Party which, in opposition, is fond of declaiming against imperialism, is face-to-face with one of the great problems of empire. Gladstone, England's great Liberal leader, often accused of being a "little Englander", found himself in a similar quandary on more than one occasion; and Sir Henry Campbell-Bannerman, another great Liberal, faced and solved the problem of the Union of South Africa after the Boer War. And it is not unlikely that a Labor Premier will find a solution to Great Britain's imperial problems. Needless to say, the action of the Labor cabinet in dealing with India will be no less firm than the Conservative.

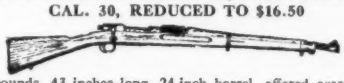


For small motors to meet your requirements—to make your product a salable one—Signal Fractional Horsepower Motors offer you the correct principles of design, made by a manufacturer who has been making small motors for forty years, and a design to make your product perform the way you intend it should perform. Either induction or series wound motors. Signal can help you. What are your motor problems? Information free.

SIGNAL ELECTRIC MFG. CO.
Menominee, Michigan

SIGNAL
MANUFACTURERS OF ELECTRICAL PRODUCTS

SPRINGFIELD RIFLE, MODEL 1903
CAL. 30, REDUCED TO $16.50



8¼ pounds, 43 inches long, 24-inch barrel, offered assembled and refinished, without bayonet at reduced price, $16.50. Ball cartridges $3.50 per 100. Illustrated catalog, 380 pages, Army-Navy equipment, mailed for 50 cents. NEW circular for 2c stamp. Established 1865.
FRANCIS BANNERMAN SONS, 501 B'way, New York City

Magic

Learn at Home, By Mail!

Scientists, doctors, all professional men and business executives find Magic a great asset. Dr. Harlan Tarbell, Famous Magic Wizard, teaches you the Principles of Magic and a marvelous array of educating and fascinating magic tricks. You learn easily and quickly at home by mail. Write today for *free* literature.

Tarbell System, Inc. 1926 Sunnyside Ave., Studio C-184 Chicago, Ill.

Books Selected by the Editors

AVIATION ENGINES—*By Ray F. Kuns, Editor, Automobile Digest*

QUITE the best presentation of the very latest types of aeronautical motors that we have seen. Each engine is taken up in detail with general construction and description of the parts, including special, individual, characteristic points comprehensively outlined. Care and upkeep are covered and various "trouble" notes are added, so that the whole is a most practical manual. $2.15 postpaid.

RADIO AND ITS FUTURE—*Edited by Martin Codel*

A COMPREHENSIVE survey of the various phases of radio communication—commercial, broadcast, amateur, industrial—each phase being covered by an acknowledged authority in his special subject. Past and present are dealt with in a comprehensive manner, giving the reader a broad background which will aid materially when following the progress of the art. Future possibilities of radio are handled with the sane foresight of the practical scientist; particularly is this true of the concluding chapter by Lee de Forest. $4.25 postpaid—*A. P. P.*

THE RADIO AMATEUR'S HANDBOOK
By A. Frederick Collins

THIS, the sixth edition of this highly popular elementary book on applied radio, has been entirely revised, rewritten, and reset. New illustrations have been added and those of the old ones that are used have been redrawn, bringing the book up-to-the-minute in every respect. This volume is directed especially to those who desire a working knowledge of the theory and practice of radio, and who have a leaning toward home construction. Various types of receiving and transmitting (C. W. and phone) sets are described, several in such complete detail that the reader can start work with the text as the only necessary guide. Appendices of Useful Information, Glossary, Radio Don'ts, Insurance Requirements, and Radio Laws, as well as a comprehensive index make the book a valuable one to every radio fan. $2.15 postpaid.

NEW BUILDING ESTIMATOR'S HANDBOOK
By William Arthur

WHETHER it be a residence or a railroad shop, a store or a school, or almost any conceivable kind of building that is to be constructed, this handbook will give information as to quantities of all materials needed and will quote comparative prices on everything from the foundation to the roof. The 15th edition of this invaluable work, long accepted as an authority by architects, builders, contractors, engineers, plant superintendents, and draftsmen, has been fully revised and enlarged. 1056 pages, 600 tables, 480 illustrations—$6.25 postpaid—*F. D. McH.*

DIE-CASTING PRACTICE—*By Marc Stern, A. C. Spark Plug Co.*

A WELCOME authoritative treatise, based on the author's long and vital connection with the die-casting industry. It represents concisely detailed and practical data on the application of die castings, the principles of design, the limitations and possibilities of the many alloys in use, and the finishes suitable to such alloys. 270 pages, 128 illustrations. $2.65 postpaid.

MATTER AND RADIATION—*By John Buckingham, Asst. Director of Scientific Research, The Admiralty*

A PECULIAR book, exhibiting a well-known English trait—it wanders casually over a large field touching with interest on this and that but without covering anything very amply. Yet the present reviewer found it so interesting that every word was read. Of the five chapters (90 pages) three are on electric waves, atomic physics, and radiation, the other two (40 pages) being on infra-red rays and their use in the detection of invisible objects, in secret signaling, fog penetration, self-steering torpedoes, navigation and so on—most fascinating things, every one—but since the author treats them with so much interest and lucidness, it is a pity that only a half portion of each could be served up. A full-sized book giving details on the same application of the infra-red if written by this author, should make reading which would defer the bed hour, for he has an evident flair for making simple things seem as simple as they really are. $3.20 postpaid—*A. G. I.*

OUR previous message to readers of these pages has been accepted so spontaneously by many book seekers, that we wish again to state, for any who did not notice the previous offer, that if you want to know what literature is available on any subject you are studying or any hobby you are pursuing, write to L. S. Treadwell, the editor who is responsible for this department and every attention will be given your request. Should there be nothing available we will be frank to tell you or advise as to the possibility of advertising for second-hand copies. Let us try to help you solve your problems.

THE ALUMINUM INDUSTRY—*By Junius D. Edwards, Asst. Dir. Research, Francis C. Frary, Dir. Research, and Zay Jeffries, Metallurgist, Aluminum Company of America.*

VOLUME I covers the history of the discovery of aluminum and the development of the industry, the ores of aluminum and their mining and refining for the production of pure alumina, and closes with a discussion of the production of metallic aluminum. Volume II gives the reader a broad view of the various processes by which aluminum is fabricated and discusses also its properties and uses. Two volumes (not sold separately), $12.50 postpaid.

THE NEW EVOLUTION—ZOOGENESIS—*By Austin H. Clark, U. S. National Museum*

IT has been said by some that Dr. Clark's new theory of organic evolution will take rank with Darwin's original theory as set forth in 1859 in "The Origin of Species." Darwin's great book created an immediate furor and the first edition was snapped up in next to no time, and first editions are today rare and highly valuable. What effect Dr. Clark's theory will have on biologic thought no one now knows but it seems certain to provoke a great deal of argument and controversy among men of science. The present volume sets forth the theory in detail and in language comprehensible to the reader of average schooling. Since it is likely to be the center of a major controversy, persons having interest in scientific events are advised to post up on it in advance and be in a position to comprehend the arguments. $3.20 postpaid—*A. G. I.*

EXPLORING FOR PLANTS—*By David Fairchild*

AN intimate narrative of a scientist's adventures in little known lands, based on notes of the Allison V. Armour expeditions. Dr. Fairchild is a botanist of note

with a remarkable record for doing things, the results of these expeditions being the introduction into this country of many useful new plants and trees. Ranking as a scientific book, its charm for the average reader lies in the ease of style and the joyous appreciation of life looked at from every angle. The story is so smooth one assimilates the botany with no effort whatsoever. Good science, good reading, good writing. We highly recommend it. Abundantly illustrated. $5.20 postpaid.

THE MATERIALS OF LIFE—*By T. R. Parsons, M.A., B.Sc.*

A "DEBUNKED" presentation of biochemistry, for the chemistry of the human body is certainly a pin on which loose statements have been hung from time immemorial. "An apple a day" does not keep the doctor away. One orange contains more vitamins than a basket of apples. Light treatments and backless bathing are popular but many of us will be surprised to learn that the effect of ultra-violet rays is similar to that of cod-liver oil. The book gives sensible as well as accurate accounts of such things as gland secretions; vitamins; the cycle of nature; food energy; the living fire; wear and tear; blood and iron; starch, sugar, and fat; digestion and indigestion, et cetera. The author eschews horrifying formulas in which those who deal with such matters professionally are wont to encyst their ideas and writes in a language which all can understand. $3.20 postpaid—*A. A. H.*

PRIMITIVE METHODS OF WORKING STONE—*By Alonzo W. Pond, Logan Museum*

THIS most fascinating book is based on the flint-flaking and artifact-making experiments and activities of Mr. Halvor L. Skavlem, mentioned on page 88 of the present number. It describes Mr. Skavlem's actual technique; therefore it is, as the author intended, a practical instruction book: "Any student who will take the trouble to read the foregoing," he says, "will be able to apply the principles as has Mr. Skavlem and like him will, with a little practice, be able to make arrowheads and other chipped instruments." The book, though paper bound, contains 143 large pages, is handsomely produced and there are 64 fine half-tone plates. It is suggested that would-be purchasers obtain it direct from The Logan Museum, Beloit College, Beloit, Wisconsin. $1.15 postpaid—*A. G. I.*

MY LIFE—*By Leon Trotsky*

MEMOIRS of the exile Trotsky ought to be interesting when we consider the enormous power once wielded by himself and Lenin. The whirligig of fate, however, has been exceedingly swift in the case of Trotsky who was sent into exile by the present Soviet government in January, 1928, and he writes his book from Constantinople. Trotsky makes note of his arrival in New York as follows: "*Sunday January 18 (1917):* We are nearing New York. At three o'clock in the morning. Everybody wakes up. We have stopped. It is dark. Cold. Wind. Rain. On land, a wet mountain of buildings. The New World!" He stayed in New York about two months and contrary to many stories his only occupation or profession was that of a revolutionary socialist. He rented an apartment for 18 dollars a month and the colored janitor ran off with three months' rent. It is by such sidelights that we enjoy a book of this kind. In attempting to return to Russia via Norway he was taken off the steamer at Halifax with his family, and placed in a detention camp, but was finally released and allowed to continue his journey to Petrograd—a journey fraught with so much history. The theme of his rise to power and his eclipse is a very long story which you will have to read for yourself. His life was weird and fantastic. $5.20 postpaid—*A. A. H.*

SLEEP—*By Laird and Muller, Colgate Psychological Laboratory*

THE many thousands who have taken keen interest in Professor Donald A. Laird's articles, published in the SCIENTIFIC AMERICAN during the past year or two, will find in this new book the substance of about 18 more equally interesting articles, all of which center around that rather familiar activity we all indulge in more or less—sleeping. After you have read this treatise you will be a sleep scientist. How can we get to sleep more quickly? How much sleep do we need? How does noise affect sleep? Do dreams affect the benefits of sleep? What types of covering, mattresses, and springs will best promote sound sleep? These are a few of the aspects of sleep covered in this semi-scientific work. The authors deny categorically that they were subsidized by any maker of beds, bedding, pyjamas, negligees, or cures for insomnia; they have tried merely to ascertain scientific facts about sleep, no matter whom these helped or hurt. The book makes easy reading, though it is packed full of fact, and is suited to the understanding of mere mortals. $2.65 postpaid—*A. G. I.*

PIONEERS OF FREEDOM—*By Sveinborn Johnson*

HERE we have vivid account of the Icelanders and the Icelandic Free State (874-1262) issued on the eve of the 1000th anniversary of the founding of the Althing or Parliament of Iceland which was celebrated by appropriate exercises on the ancient site where that body regularly convened for approximately 900 years. It is interesting to see how these isolated people founded and maintained governmental institutions while the rest of Europe was largely in the grip of absolute power and centralized monarchies. Iceland maintained a government strikingly free and responsive to the popular will. This far-away island was perfecting popular institutions while most of contemporary Europe was drifting towards despotism. Under the influence of civil and political liberty there flourished a legal system which in excellence rivaled that of Rome; and during the same period a literature blossomed which contained some of the finest creations of the human mind. The government finally collapsed because of elementary defects and a spirit of lawlessness. $3.70 postpaid—*A. A. H.*

VERDUN—*By Marshal Petain*

THIS is a definite record of the most heroic and spectacular last-ditch defense of the great war written by the man himself who conducted that defense to a successful conclusion. The author presents no argument, makes no bid for fame, he tells the facts with an impartiality that is amazing. Judgment on the German commanders is free from bias; the Crown Prince is given credit for a humanity the world has little suspected. But the most significant statement, in view of the comparatively quick demolition of Liege, Namur, and Maubeuge, is that permanent concrete fortifications such as Douaumont when properly manned and equipped can be of indispensable value in maintaining a defense and will resist the fire of the heaviest ordnance. The style of narrative is of such perfection and the generalizations are so clear and comprehensive as to make this work one of the literary gems of war history. $4.20 postpaid.

PRINCIPLES OF SCIENTIFIC PURCHASING—*By Norman T. Harriman, Bureau of Standards*

A LONG experience in railroad purchasing and specializing for the last nine years in the standardization of purchasing and its procedure of the Federal Government under the Bureau of the Budget, has given the author a sweeping comprehension of the fundamental necessities, the basic rules of scientific buying, and the philosophy of Budgetary Control that applies equally well to private business. A complete summary and thorough analysis of the best present day practice. $3.25 postpaid.

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Attorney's Delay Unavoidable

A DELAY of a few months in filing an application for a patent, due to the accumulation of business before the patent attorney entrusted with the filing, does not show a lack of diligence on the part of the applicant in prosecuting his claim to an invention and a patent therefor, the Court of Customs and Patent Appeals has ruled in an appeal from an interference proceeding in the Patent Office, according to *The United States Daily*.

The court held that the Patent Office had properly awarded priority of invention to George W. Heise as against the senior applicants, Martus & Becker, for certain improvements in battery cells.

The invention, the opinion states, "relates to the addition of zeolitic agents—one of which is 'permutit'—to the electrolyte in a caustic alkali electric cell for the purpose of increasing electrolyte efficiency."

Plan to Include Patents in War Settlement Favored

THE House Committee on Ways and Means at a recent hearing agreed to report favorably a bill (H.R. 9142) to extend jurisdiction of the Arbiter under the War Claims Settlement Act of 1928 to "patents licensed to the United States pursuant to an obligation arising out of their sale by the alien property custodian."

The purpose of the bill, according to the Special Assistant to the Secretary of the Treasury, E. C. Alvord, who testified before the Committee, is to extend the Arbiter's jurisdiction to the chemical foundation patents.

The 1928 act provides for compensation to alien owners of patents for use, or licensed to be used, by the United States, the licenses being restricted to those issued by the alien property custodian. That, according to the Government, left out the so-called chemical foundation patents, and at the time the case of the Government against the chemical foundation to set aside the sale of the patents involved, on the allegation of fraud in the sale, was pending in the courts.

Limited Novelty—Limited Claims

THE Board of Appeals has held that one claim only is allowable in a patent application covering an invention relating to the production of a water-resistant, porous, rigid, coherent mass by puffing the mixture of a ground filler and a water solution of sodium silicate, according to *The United States Daily*.

The slight novelty of the invention over the prior art was held to warrant the allowance of but one claim, the others being held not to be patentably distinctive.

The finished product of the invention is said to be suitable for use as a building material. The invention is alleged to be based on the discovery that the maximum resistance to moisture is obtained under certain conditions, they being: Particle size of the ground filler, composition of sodium silicate solution, and ratio of sodium silicate to filler.

British Mail Ban on Cigarettes

GREAT BRITAIN is seizing parcels containing sweetened cigarettes made in America and other countries which are being sent through the parcel post mails in violation of British postal regulations, according to advices received by the Post Office Department and made public in a memorandum sent to postmasters, who are to advise mailers that such parcels will be accepted only at their risk.

The brands of cigarettes affected are all popular in America, and are mailed principally by individuals as gifts to friends abroad and not by the manufacturers who sweeten their products to meet the taste of smokers, it was stated orally.

The full text of the memorandum follows:

In view of the existing prohibition in Great Britain against the importation of sweetened cigarettes, numerous reports of the seizure of parcels containing these articles are received from the postal administration of that country.

As practically all brands of cigarettes manufactured in the United States contain a certain percentage of sweetening properties, postmasters will advise mailers that cigarettes addressed for delivery in Great Britain will be accepted only at their risk.

Reduction to Practice Governs Priority

AFTER an invention has been reduced to practice, the abandonment of the invention will not be inferred merely from failure speedily to file an application for patent or to commercialize the product, the Court of Customs and Patent Appeals has ruled. Abandonment must be affirmatively proved, it was ruled, according to a recent issue of *The United States Daily*.

The opinion of the court states that "the diligence required of one claiming to be an inventor is primarily diligence in reducing to practice after conception, and the law is not so much concerned with speed in filing application for patent, provided, of course, there is no secreting or abandonment of the invention."

The court affirmed the Patent Office in awarding priority of invention for a process of manufacturing formamide to Burritt Samuel Lacy, who did not file an application for patent until three years after the conception of the invention and its reduction to practice.

The subject of the invention, according to the opinion, is a "process for the production of a material called formamide, one of the uses of which is as a raw material in the production of hydro-cyanic acid much used as an insecticide for fumigating citrus trees, ships, rooms, and so forth."

In another case involving the question of reduction to practice, the Court of Customs and Patent Appeals has upheld the Board of Appeals of the Patent Office in ruling that priority of an invention of a process for vulcanizing rubber involving the use of so-called high-power accelerators should be awarded to Sidney M. Cadwell over Marion M. Harrison and Harold A. Morton, whose assignee is the owner of patents No. 1434892 and No. 1434908, for the process. The patentees were the junior parties, the Cadwell application having been filed previous to theirs, although patents have been issued to them.

The opinion describes the steps that have been taken in the art of vulcanizing rubber. Problems arising in the use of high-power accelerators were solved by both parties, it is stated. The sole issue between the parties on appeal was which had first reduced the invention to practice.

The court held that the numerous laboratory tests conducted by the appellee in the usual way for determining proper vulcanizations, which tests were in common use in the rubber laboratories of the country, constituted a sufficient reduction to practice although no factory tests were made nor commercial operations conducted.

Pay for Service Is Not Free

"FREE" spectacles to a customer who would obtain orders for glasses from other persons were offered by the Clear Sight Spectacle Company, Chicago, but the glasses were really not free, according to the findings and an order to cease and desist just issued by the Federal Trade Commission.

"Take the scientific self-tester you now have to your friends," the customers were advised. "Ask them to make a test of their eyes as you have done. They too should have the benefit of our expert service and low price.

"Tell them you are going to order a pair for yourself and that they might as well send their orders with yours.

"Collect one dollar deposit from them and they can pay the balance to the mailman upon delivery. They will receive the same, strong iron-clad guarantee of satisfaction for five years to come.

"You may keep the one dollar deposit you collect as your pay. Take only four orders and you will earn more than enough to pay for your own glasses. Take as many orders as you can. You make one dollar each."

The Federal Trade Commission has ordered the company to cease and desist from representing the spectacles as "free" when the fact is they are not given free but "in consideration of personal services rendered or performed by certain customers in securing for respondent cash orders

for two or more pairs of its spectacles from other customers."

Customers were invited to take two orders with a dollar deposit on each, send in the two orders and the two-dollar deposit. The person taking such order was to obtain his own glasses "free."

"Only one free pair of spectacles will be sent into a community," read an advertisement.

In one instance the company described its proposition as a "Special Ten Day Offer."

But the commission has also ordered the respondent to discontinue representing that the spectacles "can be obtained at the prices stated for a limited period of time only, or that said spectacles can be purchased by a limited or restricted number of persons only," as these restrictions were not put into effect.

"Army and Navy Supplies" May Be Misleading

NATHANIEL ABRAHAM, trading as N. Abraham Company and Warehouse, in San Francisco, offered for sale paints, automobile oils, and varnishes as "Army and Navy Surplus Supplies," when in fact this merchandise had never been the property of the United States Government.

In his advertisements Abraham displayed the following notices: "This Merchandise is Now Offered for Sale at Warehouse, 701 Battery Street, Corner Pacific," and "Warehouse, 701 Battery Street, San Francisco; Mail Orders Promptly Attended To."

Abraham was ordered by the Federal Trade Commission to cease and desist from these misleading uses of the words "Army and Navy Surplus Supplies," or the word "Army" or the word "Navy" standing alone or in connection with the word "Warehouse" or with other words.

Parachutes Are Developing

AFTER several years of more or less stagnation, development of parachutes for use of aviators has taken place, according to J. E. Sullivan, of the Bureau of Aeronautics, Department of the Navy.

The industry is a growing one, said Mr. Sullivan, who pointed out that the latest figures compiled by the Aeronautics Branch of the Department of Commerce show that the number of aircraft pilots holding active licenses now totals 10,701. Furthermore, parachutes constitute no minor item in the equipment of an aviator, as they sell commercially for approximately 350 dollars each, although they are bought for military purposes for considerably less.

A cotton substitute for the silk used in parachutes is being subjected to experiments, which has the advantage of being cheaper than silk. While commercial interests are employing cotton to a certain extent, the Bureau of Aeronautics has not arrived at any definite conclusion regarding its use for naval purposes.

There are four major manufacturers of parachutes today while there were only one or two five years ago. A recent improvement made by one manufacturer has been to make the pack perform the functions of the pilot parachute. The pilot parachute on the ordinary parachute is the first to open and drags the large one after it. When the rip cord releases the spring on this new type the bottom of the pack opens and replaces the usual pilot 'chute.

Another manufacturer has improved his product by reducing the size, which, although it makes the rate of descent somewhat faster, opens more quickly. Still another manufacturer, it was pointed out, is working on a triangular-shape parachute, which is claimed to be steerable.

Nearly all the accidents in the past due to the failure of the parachute have been attributable to improper packing or improper operation of the releasing device by the person making the descent, or hasty release of the spring, causing the parachute to open too quickly and catch on the plane.

The present development of parachutes is being worked out to a large extent on increasing their performance characteristics—making them stronger, more durable, with smaller packs and less bulky. The features which the Navy looks for in a parachute are the certainty and rapidity of opening, slow rate of descent which must be about 20 feet per second, and non-oscillating.

"Dry Ice" Package Patent Valid

THE Slate patent, Number 1595426, for a refrigerating apparatus using solid carbon dioxide, so-called "dry ice," principally used for packing for shipment food products not damaged by excessive freezing, has been held valid by the Circuit Court of Appeals for the Second Circuit.

The defendant company, which was alleged to have supplied solid carbon dioxide for use in the plaintiff's packages, was also held by the court to be a contributory infringer of the patent.

The court over-ruled the defense of invalidity of the patent, holding that while the use of carbon dioxide as a refrigerant had been long known in the art, the arrangement adopted by the patentee in his apparatus was not anticipated.

The patentee was stated to have reversed the usual process by placing the refrigerant in the center of the package, surrounding it with ice cream or other substance to be refrigerated, and enclosing all in a packing box or insulating wrapping.

The court held that the method of utilizing by specified physical means the operation of a law of nature is patentable, thus overcoming the objection that a law of nature may not be patentable.

It was also found not to be fatal to the patent that the solid carbon dioxide is to be destroyed by its use as a refrigerant.

The doctrine of implied license to renew perishable and subordinate parts was also held not to be applicable to the perishable solid carbon dioxide, particularly where the exclusive licencee of the owner of the patent sells carbon dioxide with a license to use it in the package described in the patent.

Malt Product Mark Restrained

THE owner of the trademark "Budweiser," for malt syrup and other products, has been held by the District of Maryland to be entitled to an injunction restraining the use of the notation "Budd-Wise" on malt products. The matter was referred to a master for an accounting.

The court ruled that the defendant's allegation in answer to the suit for infringement that the plaintiff was deliberately and intentionally selling its goods for use in violation of the prohibition act and that its goods are not fit for legitimate use should be stricken from the pleadings as irrelevant and impertinent.

It was further held that the fact that the defendants had procured a copyright of their label was immaterial in a controversy as to trademark infringement, the copyright giving the defendants no trademark rights whatsoever.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payment must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

AEROPLANE—An amphibian air liner, in which the body simulates a bird, is particularly adapted for flying in sleet and snow, exhaust gases being utilized for heating the body and for preventing the formation of ice on the wings. Patent 1757879. John T. Rydberg.

Pertaining to Apparel

REAR YOKE FOR DRESSES—A reinforcement which extends from the rear opening at the neck to the sleeve openings and downwardly to the lower part of the sleeve opening for protecting the dress against perspiration without detracting from the pleasing appearance. Patent 1758852. Louis C. Rosenblatt.

Chemical Processes

PROCESS FOR RECOVERING BORAX FROM BRINE—Containing borate in solution together with sodium carbonate, which consists in treating the brine with carbonic acid gas to precipitate from the solution, and crystallizing out the borax by cooling. Patent 1756122. Henry D. Hellmers.

PROCESS FOR INCREASNG THE LUSTER OF GOODS MADE OF ANIMAL HAIR AND WOOL—Particularly felt and velour in hat bodies by bringing into contact therewith an aqueous solution containing chlorine and hydrogen ions, and an aqueous solution of peroxide of hydrogen, and causing the two to react with each other in contact with the goods. Patent 1760738. Erich Bohm.

Designs

DESIGN FOR A DRESS—Patents 81098 and 81099. Dorothy Long.

DESIGN FOR A TEXTILE FABRIC OR SIMILAR ARTICLE OF MANUFACTURE—The inventor has been granted two patents, 81252 and 81255. Joseph H. Mack.

DESIGN FOR AN ENSEMBLE SUIT—Patent 81139. Dorothy Long.

DESIGN FOR A SUSPENSION BRACKET—Patent 81168. Robert D. W. Vroom.

DESIGN FOR A CANDY DOLL—Patent 81245. Mildred C. Knapp.

DESIGN FOR AN ENSEMBLE SUIT—Patent 81251. Dorothy Long.

DESIGN FOR A TEXTILE FABRIC OR SIMILAR ARTICLE OF MANUFACTURE—The inventor has been granted two patents, 81235 and 81236. Herman Haug.

DESIGN FOR A TEXTILE FABRIC OR SIMILAR ARTICLE OF MANUFACTURE—Patent 81238. Christian Hoffmann.

DESIGN FOR A SUIT—Patent 81100. Dorothy Long.

Electrical Devices

ELECTRIC FURNACE—Such as those usually employed in dental laboratories, which will be capable of generating the necessary amount of heat with much lower resistance than usual, constructed in a simple manner prolonging the life for an indefinite period. Patent 1757895. Andrew J. Asch.

RADIO TUBE—Which may be used in several different ways, such as a detector, an amplifier, a static eliminator, etc., provision being made whereby the characteristics of the tube may be changed to effect the desired results. Patent 1757345. Howard M. Strobel.

THERMOSTAT—Forming part of an electrical circuit, in which a thin strip of resilient material is bent and maintaned under a predetermined stress, so that when expanded by heat it will suddenly buckle, thus instantly breaking the circuit. Patent 1758787. Arnold Escher.

ELECTRIC WATER HEATER—Adapted to be readily associated with or removed from a sink or similar kitchen or household fixture, whereby the water passing through coils brings it in contact with various portions of the heating element. Patent 1759774. Angelo Andriulli.

FLUID-OPERATED CIRCUIT CONTROLLER—Which is capable of controlling a circuit including a signal for indicating to the operator of a motor vehicle whether or not the lubricating system of the vehicle's motor is properly functioning and sufficient lubricant circulating. Patent 1759537. Walter C. and Arthur R. Buckbee.

Of Interest to Farmers

STALK CUTTER—A farm implement which includes a frame having equal portions extending on opposite sides of a draw bar and carrying knife-equipped rotors for cutting stalks and chopping them up, over at least four rows. Patent 1757873. John F. O'Kelley.

Of General Interest

MARCELLING IRON—Comprising a plurality of forks disposed one above the other and means for moving certain of the forks laterally with respect to the others, the other forks remaining stationary, may be worked in the same manner as hair clippers. Patent 1756104. Nellie Stone.

CONDIMENT HOLDER—A partitioned container, wherein salt and pepper may be served from a single holder, the construction is simple, while at the same time functioning to prevent the mixture of the condiments, and keep them moisture proof. Patent 1757525. Frank A. Hart.

EASEL—Comprising two strips of material forming a U-shaped frame having an L-shaped bracket capable of holding and displaying thin objects such as paintings or photographs, or thicker objects such as books. Patent 1755518. Edward M. Roberts.

CLOSURE CAP—For milk bottles, or any form of container where disk-shaped cardboard caps are used for closures, whereby the cap may be gripped by the hand and easily removed entirely eliminating the use of an instrument. Patent 1755522. Samuel J. Smyth.

OPTICAL DEVICE—Primarily intended for amusement purposes, optical illusions being produced when viewed by a person, or if employed in connection with an ordinary or motion-picture camera, such optical illusions will be reproduced on the film. Patent 1758801. Bertram Moses.

MEANS FOR ACOUSTICAL CORRECTION AND SOUND DEADENING—For absorbing sound by causing reverberation or resonance of sound in a manner which eliminates interfering echoes, or which confines sound refection to a determinate non-interfering limit or area embodied by walled structures. Patent 1758808. Fred J. Sersen and Kenyon B. Conger.

PLANT SUPPORT—For growing plants which includes a post adapted to be driven into the ground alongside of the plant and a girdle adjustable, vertically on the post and circumferentially, in order to compensate for growth of the plant. Patent 1758839. Theodore Kelsey.

ADJUSTABLE MIRROR FOR BARBERS' CHAIRS AND THE LIKE—Whereby the mirror may be moved to various positions so that the occupant of the chair may view the results of a hair cut, wave, or the like, the mirror being adjustable for customers of different heights. Patent 1758021. Peter D. Barakauskas.

ASPIRATING HEAD FOR FLOWING LIQUIDS—An aspirating head for submergence in a well or reservoir of liquid to produce a jet of suction-producing gaseous fluid under pressure causing movement of the liquid in a flow line. Patent 1758812. George McW. Williamson and Glasgow W. Haywood.

TELLURIAN—An orrery, specifically a tellurian having sun and earth sphere mounted for bodily movement of the earth relative to the sun in a path denoting the ecliptic circle. Patent 1758759. David Phillips.

COMBINATION BRUSH, COMB, AND MIRROR—In which the various parts are entirely enclosed when not in use, thus keeping them clean and sanitary, the casing being divided into brush-receiving and comb-receiving compartments, one of the partitions forming a mirror. Patent 1757999. Christoph Hagen.

PRICE TAG OR SIGN HOLDER—An attachment for supporting tags from the edges of shelves, which affords a means for associating the tags either in an upright or depending position, an advantage where two varieties of stock are arranged on one shelf. Patent 1759781. Louis Fontannaz.

LOUD-SPEAKER ENVELOPE—Comprising an envelope body including conical walls secured together at the major portions of their edges, leaving an opening constituting a sound outlet, functioning to produce more individual notes and less harmonics. Patent 1759785. Roy H. Guldman.

COOKING POT OF THE SELF-CLOSING TYPE FOR THE COOKING OF FOOD—Having a cover adapted to be placed in position and removed, by sliding and rotating horizontally, thereby preventing its contact with the food and providing more food-containing space within the vessel. Patent 1759732. Moise A. Charlot.

SEAT BACK-REST—A collapsible back-rest for association with board seats, such as are employed in row-boats and bleachers on baseball and athletic fields, thus producing a comfortable and rigid seat structure which may be effectively secured. Patent 1759694. Peter Greenwood.

DEVICE FOR REMOVING EGGS FROM FISH HATCHERIES—More particularly for the separation and removal of dead eggs from the live eggs in the hatchery troughs, thus preventing the development of fungus liable to destroy the health of the live eggs during the period of incubation. Patent 1759729. Joseph Berger.

NESTED CHAIR—Which may be formed as a chair or a table and readily nested for shipment or storage, the structure being formed either of wood, metal, or a combination, and the parts so constructed as to telescope. Patent 1758826. Louis Dellert.

MASSAGE DEVICE—Which comprises a plurality of vacuum cups, one being disposed within the other, the inside one being of less height than the outside one, thus producing a greater suction and a more effective massage to the skin. Patent 1758962. Carl Miller.

ADJUSTABLE FURNITURE—Especially adapted for printing establishments, having two opposed edges swingable at various angles with respect to each other, so that a cut may be locked in the chase on a bias, thus obviating the use of specially cut wood. Patent 1758980. Wayne F. Rossiter.

SAFETY BARRIER FOR ROADWAYS—For placement along dangerous curves or embankments on a highway, which in the event of being hit by a motor vehicle will eliminate or reduce the shock to a minimum, both to the barrier and the vehicle. Patent 1759794. William McDade.

OARLOCK—Formed integral of metal, with an oar-receiving eye supported for swinging movement by a pin and socket in upright position above the gunwale of a boat, and having means for preventing displacement of the oar during rowing. Patent 1757378. John E. Mathewson.

COMBINATION LADDER, STEP AND SUPPORT—Which may be positioned wherever desired, along the length of the ladder at an angular position of a building or roof, and will also function to support a bucket. Patent 1760803. John Wirth.

HOSE COUPLING—Consisting of male and female members with simple means for positively locking them to form a fluid-tight joint, and whereby a worn male member may be replaced by a new one and the desired connection assured. Patent 1761352. Henry H. Logan.

MEMORY PAD—Having means for covering a portion of the subject worked upon, thus causing the student to recall by memory the portion covered, the entire sheet may be covered for constant repetition until the problems are memorized. Patent 1760408. Rebecca E. Hooper.

STOPPER FOR GAS AND WATER MAINS—An inflatable stopper which will be effective in forming a complete closure for the main, the proper emplacement not being prevented by buckling or deformation after its insertion, means are provided for ready insertion and removal. Patent 1760750. Patrick Goodman.

DISPLAY DEVICE—Showing in miniature the reproduction of a pattern of dress material proportionately reduced to enable a purchaser to determine how the garment will look when made up, through a reduced picture of the garment and the material selected. Patent 1760792. Bernard F. Stenz.

MOUNTING ANCHOR—Particularly adapted for mounting the corner clips in decorating pocket books, bill files, wallets, or the like, serving to positively secure the clips in attached relation, without marring the appearance of the cover. Patent 1760728. Murray A. Wachs.

COMB—Characterized by being conveniently manipulated to form a compact case excluding dust and dirt, may be carried in a pocket, pocketbook, or form part of a traveling kit, the teeth are formed to be substantially self-cleaning. Patent 1760778. Henry J. Ries.

ARTICLE SUPPORT—A simple means for holding paper or other bags in open position, for dropping into the same waste material or refuse from household kitchens, the bag may be readily detached from the support and placed in a garbage can. Patent 1760752. George D. Happer.

Hardware and Tools

HOE—Having a plurality of interchangeable blades for performing various garden operations, and a durable and interchangeable shank is provided between the blade and handle for withstanding a maximum strain; handles of various length may be used. Patent 1757882. Ernest F. and Alfred Sill.

CASING CUTTER—Which is provided with automatic means for gripping the interior wall of the casing at any desired depth, the cutting means being actuated by the weight of the drill stem, and jars for severing the casing. Patent 1756128. Albert M. Monroe.

SUSPENSION HOOK—Which may be formed from a single piece of metal, will be durable and will readily support a framed picture or the like at various angles, without liability of slipping, or disengagement of the suspension cord. Patent 1757875. Thomas S. Rainey.

LOCKING DEVICE—Especially adapted for windows, automatically locking the sash together when in closed position and providing means for rigidly holding the window against lateral vibration, may be readily used on doors, cabinet doors or the like. Patent 1758337. John C. Sheller.

KNOB-ATTACHING DEVICE—For securely holding the knobs of covers for pots, kettles and the like, may be readily screwed into place, and is automatically locked against accidental removal, may be used in connection with old covers. Patent 1759771. Otto B. Willi.

ADJUSTABLE CUTTING INSTRUMENT—In which a blade is provided with two cutting edges adjustable to expose more or less of the edge as required, whereby the manual manipulation of the cutter or scraper will be greatly facilitated. Patent 1755535. Otto M. Bratrud.

WRENCH—Having a jaw head which may be manually rotated to assume various angular positions, so that it may be used from different starting positions in operating a nut or bolt which is particularly difficult of access. Patent 1755486. Ross E. O'Dell.

LOCK—A simple locking means wherein the bolt is projected by gravity, eliminating the use of springs, which cannot be "picked" or manipulated by a skeleton key, from the outside of the door. Patent 1758872. Robert Wheeler.

Heating and Lighting

FURNACE—Having a coal hopper in open communication with the casing, and a mechanical stoker operated from the floor above adapted to force a charge of fuel onto the grate, the fuel, including the volatile products being completely consumed. Patent 1757878. Carl H. Root.

ATTACHMENT FOR GAS WATER HEATERS—A form of cowl, readily applied to the conventional type of heater, serving to direct the hot gases into intimate contact with the hot water discharge pipe, before such gases are dissipated into the air. Patent 1758788. Alexander H. Frank.

DOMESTIC INCINERATOR—Which rapidly desiccrates refuse and maintains a sufficiently high temperature to drive off volatile moisture without recondensation in the incinerator or in the stack, completely consuming fats, carbohydrates and other garbage without appreciable odor. Patent 1758487. Harry L. Warren.

Machines and Mechanical Devices

CENTRIFUGAL PUMP—In which roller bearings and lubricating oil may be used, all possibility of the oil coming in contact with the liquid passing through the pump being eliminated by the use of wear-compensating rings, instead of packing. Patent 1757670. Herman L. Keun.

MECHANICAL PENCIL—Wherein a thin flat lead may be employed and fed as desired, at all times producing a line of uniform width, particularly adapted for draftsmen requiring a certain kind of point for their work. Patent 1757884. Edgar C. Tuggle.

PUMP—Wherein a sort of floating dam may be mounted in a comparatively swift stream, to form a double acting force pump driven by a waterwheel, for delivering a maximum quantity of water to any desired point at minimum cost. Patent 1757885. Grant Weaver.

OIL PUMP—Adapted for continuous high-speed operation in connection with oil or other wells of great depth, being operable with a minimum of care, and containing few parts which are liable to get out of order. Patent 1755516. Edward P. Reynolds.

METHOD OF AND APPARATUS FOR REACTIVATING CHARCOAL—For the revivification of charcoal laden with organic matter as in sugar refining, by passing the charcoal through a kiln and subjecting it to a continuous recirculation of pre-heated hot gases which support the combustion of organic matter. Patent 1758202. Edgar W. Rice.

SHIP-PROPELLING MEANS—A form of hydraulic ship propulsion, an assemblage of mechanism whereby a jet or stream of water is directed rearwardly and downwardly for propelling a ship forwardly, or in a forward direction for reversing the vessel. Patent 1758847. Amos C. McIntosh.

OIL-WELL PUMP—In which the expulsion of a combustible gas is employed in such relation to the oil within the well as to subject the latter to a series of lifting impulses, until it is finally ejected from the well. Patent 1758346. Armais Arutunoff.

FLUID-DISPENSING APPARATUS—Characterized by its ability to control dispensing of different flavoring syrups from different sources of supply, and carbonated water, through a single nozzle, and by the employment of a single valve, particulary adapted for use at soda fountains. Patent 1758552. Philip S. Allen.

GAS AND LIQUID CONTACT APPARATUS—A tower for the absorption of gases in liquids or their distillation therefrom, means for delivering liquid from one section to another, a plurality of enclosed bubbling trays, and means for controlling the temperature of particular trays. Patent 1759750. Meinhard H. Kotzebue.

VARIABLE-SPEED MECHANISM—In the form of power-driven or automatic scissors intended especially for barbers' use, may be driven by any suitable means, for instance, an electric motor or other power or by hand. Patent 1760712. Tatsuji Morimoto.

DRY-CLEANING MACHINE—Characterized by the functional relationship of a movable body, within a casing, upon which apparel to be cleaned is supported and adapted to move in a cleaning liquid, and to circulate the liquid around and through the article. Patent 1760218. Onesime Thibault and Robert Reid.

INDICATOR FOR WRECKED SUBMERGED CRAFTS—Such as submarines, boats, aeroplanes, etc., in which novel means of pressure-actuated release is used for freeing a buoy when the craft sinks to a predetermined depth, or may be manually or automatically released. Patent 1759839. Peter M. Cirimele.

GRADER FOR VEGETABLES, FRUITS AND THE LIKE—A rotatable sorter, in which the articles to be graded are fed to one end of the machine and during their passage therethrough are discharged at different points according to the sizes of the articles. Patent 1760742. William G. Bunker.

CURTAIN HOLDER—Which may be attached and positioned to hold a window shade away from the window so as to permit a free circulation of air without permitting a view of the interior of the room from outside. Patent 1760701. Godel Kalenoff.

Plumbing and Fittings

COPPER - BOILER OUTLET — Wherein the threaded portion of the outlet is welded to an extension of the boiler with anchoring means for including solder surrounding the thread, whereby a mechanically strong and air-tight structure is produced. Patent 1758869. Albert H. Trageser and Louis Hassinger.

Pertaining to Recreation

FISH LURE—An artificial bait, for casting, trolling, or still fishing, which when grasped by the fish will automatically release a hook so that the fish will be impaled thereon, a smooth surface preventing entanglement of the bait with weeds. Patent 1758817. Elwin J. Babbitt.

STIRRUP—Having flexible portions for obviating the possibility of a rider's foot being held in the stirrup, should the rider be thrown out of the saddle, and which is more comfortable than the usual rigid type of stirrup. Patent 1758930. Archibald D. Cameron.

TOY PISTOL—Adapted to hold and "shoot" by release, a plurality of elastic bands held under tension and successively releasable rapidly or at intervals as desired, the toy having the properties of a "repeater" or magazine pistol. Patent 1759084. Fred T. Baum and Clarence G. Norris.

Pertaining to Vehicles

VEHICULAR SIGNAL—Whereby semi-flexible arms are adapted to advise traffic in front or behind the vehicle, the turning direction by mechanism positioned on the steering column, whereby the indicators may be manually controlled for visual positioning. Patent 1757869. William Lipsky.

VEHICLE SPRING—In which friction between the leaves is increased on the recoil, thereby damping the spring action so that the recoil is much slower, thus improving the riding quality of the vehicle and increasing the life of the leaves. Patent 1757405. Edwin Bagnall.

REFLEX SPRING—Wherein the action on the downward thrust is free, thereby providing a device which loses none of the easy riding qualities, one of the spring leaves acting as a fulcrum for dampening the action on the recoil. Patent 1757406. Edwin Bagnall.

SAFETY VALVE FOR TIRES—Whereby the inflation may be produced to any predetermined pressure within the limits of the gauge, and upon reaching the predetermined pressure an audible signal will be given preventing further inflation, thus avoiding danger of over-inflation. Patent 1759796. Albert R. Miles.

MOTOR-VEHICLE HOLDDOWN—Constructed from lengths of iron rod bent to provide divergent anchoring barbs at the ends for penetrating the floor of a freight car, for holding automobiles or other vehicles against rolling while in transit. Patent 1759733. William B. Cook.

ROAD MAGNET—Which may be mounted on a suitable vehicle, preferably a motor truck, and drawn over the road for picking up objects liable to puncture tires, the magnetizing motor may be readily removed and used for other purposes. Patent 1759687. Walter M. Carter.

VENDING MACHINE—A form of tricycle, the hollow body of the vehicle being in the shape of an airplane, having storage space for commodities, and a seat from which the operator may manually propel the mechanism and control the steering. Patent 1758432. James T. Crow.

STEERING GEAR—Whereby steering wheels may be set in true alinement even though the steering axle bolt be sheered or otherwise defective, thus increasing the life of the tires and at the same time permitting free and easy steering. Patent 1760749. John F. P. Gillespie.

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG., 24-26 West 40th St., N. Y. C.
INTERNATIONAL BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - San Francisco, Cal.
SPRECKELS BLDG. - Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request

Associates in All Foreign Countries

WANTED
Services of
PATENT OFFICE DRAFTSMAN
Permanent employment in industry which is yet in its beginning. State age, where last employed, wages expected and past experience.
Address Box 197, Scientific American

MAKE YOUR INVENTIONS PAY

Millions have been made from ideas properly developed and protected by inventors. One of the first steps is the development of a practical working model. Send us rough sketch or model of your idea. We will submit complete report backed by 30 years experience in model making. Confidential service. Modern equipment. Bank references furnished. FREE booklet "Making Inventions Pay."
CRESCENT TOOL COMPANY, Dept. H, Cincinnati, Ohio

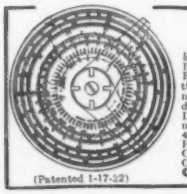
I SELL PATENTS
If you wish to add New Products to your line, or have a good Patent to sell, write me—
CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

Specialize complete Manufacture, Tools, dies, special machinery
MODELS MADE
ATLAS INDICATOR WORKS
817 W. Washington Blvd. CHICAGO, ILL.
Telephone: Haymarket 1864

NEW PATENT FOR SALE
ROAD MARKER (PAINTER)
Send for Photo
W. B. BURNLEY
6533 Meridian St. Los Angeles, Calif.

INVENTOR'S UNIVERSAL EDUCATOR:
Contains 900 mechanical movements; 50 Perpetual Motions; instruction on procuring and selling patents and selecting an attorney, etc. Suggests new ideas. Price $1.00 postpaid in U. S. A. Address Dieterich Company, Publishers, 602H Ouray Building, Washington, D. C.

Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City



(Patented 1-17-22)

The Midget "Five-in-One" Slide Rule
is a combination Mannheim, Polymetric Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Fabrikoid Case, 50c extra. Sent C. O. D. if desired. Catalogue Free. GILSON SLIDE RULE CO., Stuart, Florida

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—AUGUST, 1930

American Pipe Bending Machine Co.	149	Metallic Sign Letter Company	149
American Telephone & Telegraph Co.	86	Wm. Mogey & Sons, Inc.	149
Atlas Indicator Works	160	Munn & Co.	149 & 160
Auburn Automobile Company	2nd Cover	Pratt Institute	151
Francis Bannerman Sons	153	R. J. Reynolds Tobacco Co.	4th Cover
Charles Bond Company	151	Science News-Letter	151
Box 197 Scientific American	160	Charles A. Scott	160
W. B. Burnley	160	O. M. Scott & Sons Company	151
Chicago Gear Works	151	Signal Electric Mfg. Co.	153
Crescent Tool Company	160	S K F Industries, Inc.	81
Dieterich Company	160	Tarbell Systems, Inc.	153
Du Maurier Company	151	Timken Roller Bearing Company	3rd Cover
Ethyl Gasoline Corporation	82	Unisol Mfg. Company	149
Gilson Slide Rule Company	160	Veeder-Root, Inc.	149
Laboratory Materials Company	151	Western Electric Company	147
Mead Gliders	149	Henry Zuhr, Inc.	160

FRANCIS N. PRUYN
Advertising Manager

GEORGE A. TOWNSEND
Mid-Western Advertising Manager

Blanchard-Nichols-Coleman
Western Advertising Representative
Los Angeles, San Francisco, Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer

LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor

ALBERT A. HOPKINS — ALBERT G. INGALLS — LOUIS S. TREADWELL
A. P. PECK — F. D. McHUGH
PROFESSOR HENRY NORRIS RUSSELL — PROFESSOR ALEXANDER KLEMIN

CONTRIBUTING EDITORS

ERNEST W. BROWN, Sterling Professor of Mathematics, Yale University.

A. E. BUCHANAN, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

PAUL R. HEYL, Physicist, United States Bureau of Standards.

DAVID STARR JORDAN, Chancellor Emeritus, Leland Stanford Jr. University.

WALDEMAR KAEMPFFERT, Director Museum of Science and Industry, Chicago.

M. LUCKIESH, Director, Lighting Research Laboratory, Incandescent Lamp Dept., of General Electric Company, Nela Park, Cleveland.

D. T. MACDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research; and President, Society for Psychical Research (London).

W. D. PULESTON, Captain, United States Navy—Technical Adviser on Military Matters.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 143, No. 2. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid.

Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," registered United States Patent Office.